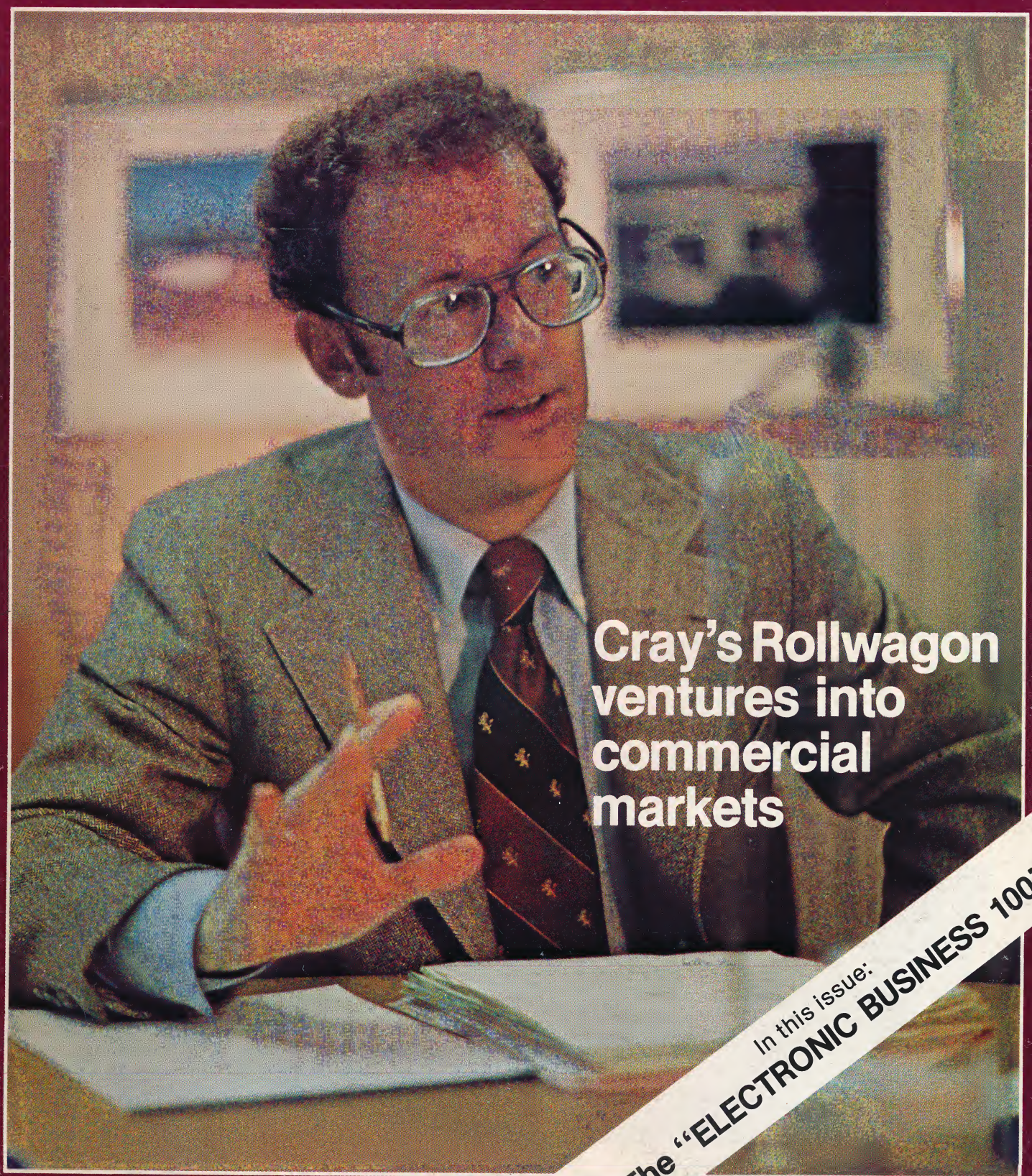
ELECTRONIC BUSINESS

THE BUSINESS MAGAZINE FOR THE ELECTRONICS INDUSTRY

Datapoint joins the fray for the text/data processing market

Guide to Plant Site Selection in the U.S.



Cray's Rollwagon ventures into commercial markets

In this issue: The "ELECTRONIC BUSINESS 100"

February 1980 / A Cahners Publication

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Discovering where the growth is

Electronics companies grow faster than nonelectronics firms, and electronics divisions within diversified companies grow faster than their nonelectronics counterparts.

Scarity. Limited resources. No growth.

Hardly a day goes by without headlines proclaiming what many people perceive will be the way of life during the rest of this century. Business analysts, in turn, extrapolate economic trends from these headlines and fear that it will be hard for companies to grow when the supply of natural resources declines.

Not for electronics firms, though. Natural resources might be getting more scarce, but the products these resources yield do not necessarily have to follow suit if we can utilize the resources more efficiently. And, because electronics is today the technology of efficiency, companies can find in electronics the growth they sought a few decades ago in other industries.

Consider, for example, firms like General Motors, Ford Motor, Boeing, 3M, Singer, Du Pont, Corning Glass, Dart Industries, Eastman Kodak and Bally Manufacturing. If you ask someone on the street—even Wall Street—what the main business of each of these companies is, the answers will be industries as diverse as automobiles, airplanes, adhesive tapes, sewing machines, plastics, glass, food containers, cameras and pinball machines. Not electronics. Yet all these companies are included in the ELECTRONIC BUSINESS 100, the list of blue-chip U.S. companies that produce or provide most of the electronic components, equipment and services in the world.*

Electronics is helping these companies grow. While as a group their electronics revenues still account for less than five percent of their total revenues, the electronics content increased at an average 30 percent annual rate from 1976 to 1978, almost twice as fast as total revenue growth.

The same thing happens throughout the list. As the bar charts on this page show, electronics revenues for the ELECTRONIC BUSINESS 100 grew faster than total revenues, whether we consider the top 10 or top 100 firms. This confirms that the reason these companies are in the electronics business is precisely the promise of fast growth, the kind of growth they used to enjoy in other businesses that have long since lost their bloom. In fact, company growth is faster as we go down the list, where firms tend to be smaller and more likely entirely electronics-oriented.

Indeed, all-electronics companies grow faster than the electronics divisions of more diversified companies. For example, the top 10 all-electronics firms that have appeared in the last three presentations of the ELECTRONIC BUSINESS 100 (Honeywell, Texas Instruments, Motorola, Digital Equipment, Hewlett-Packard, Zenith, Tektronix, National Semiconductor, General Instrument and Fairchild Camera and Instrument) grew faster than the electronics portions of the overall top 10 companies.

As electronics becomes a more visible part of diversified companies, we can expect the following trends to develop during this decade:

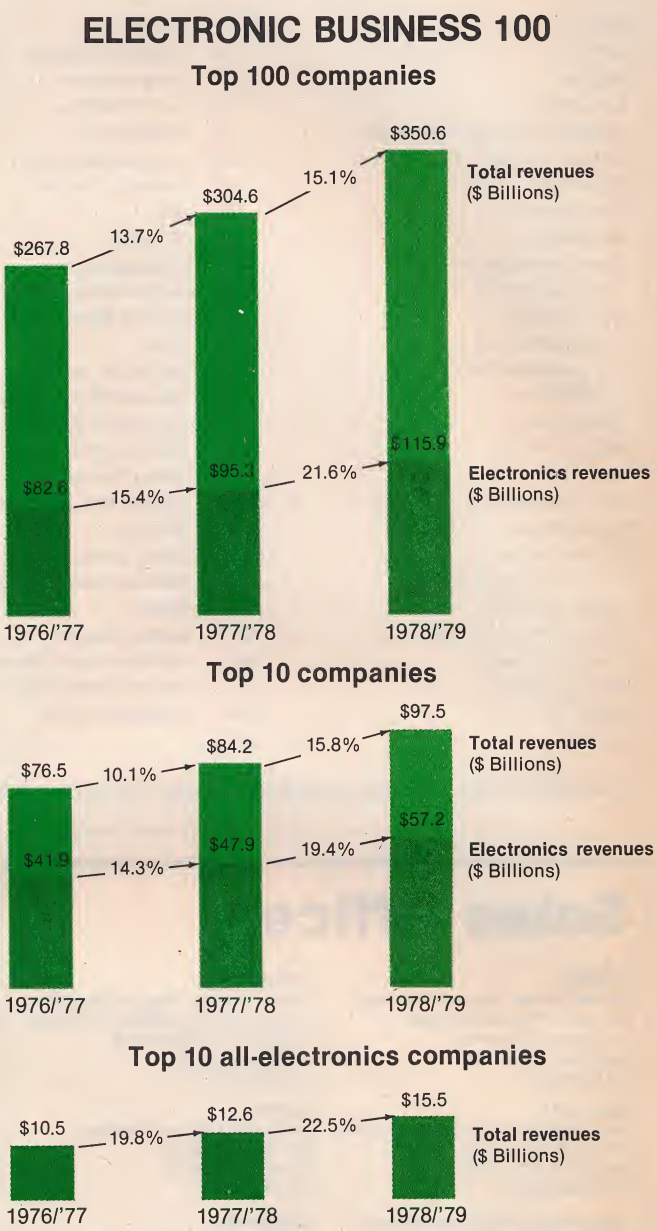
Acquisitions of electronics companies. It's already easier for a company to number among the ELECTRONIC BUSINESS 100 by acquisition—as Dart has done in this version of the list and Eaton will in the next—than by growth, as Oak Industries has done.

Capital investment. Leading companies, such as the ones that make our list, will need to invest in capital at a rate faster than their sales growth. Companies that cannot invest at such a rate are likely targets for acquisition.

Management. As the electronics divisions of diversified companies grow and become more important portions of their parent companies, their management will be called upon to lead the parent. This speeds up the penetration of electronic technology into the parent's products—already the case at Harris—thus increasing electronics revenues even faster.

Less than 25 percent of the country's 100 largest industrial corporations appear in the ELECTRONIC BUSINESS 100. This percentage should double during this decade, as electronics becomes increasingly recognized as a growth industry by the man on the street—especially Wall Street.

Alberto Socolovsky
Publisher



*This issue of ELECTRONIC BUSINESS features the latest version of the ELECTRONIC BUSINESS 100. An updated list will appear in our August 1980 issue.

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February 1980

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To receive more information on the industrial plant sites advertised in this issue, circle the corresponding number on the inquiry card that appears on page 115.

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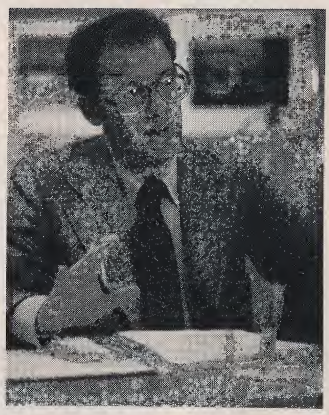
ELECTRONIC BUSINESS

THE BUSINESS MAGAZINE FOR THE ELECTRONICS INDUSTRY

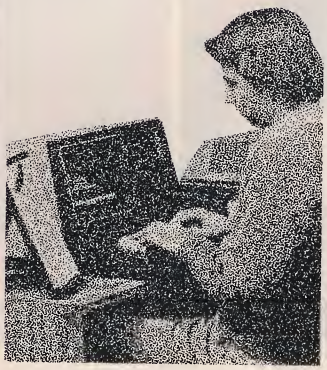
Featured this month

News in perspective

Company strategies



Cray Research's John Rollwagon: *"We can't sit still or we'd be overrun."* (Page 66)



Datapoint's *integrated electronic office puts the firm in the competitive mainstream.* (Page 52)

1	IBM
2	ITT
3	Western Electric
4	General Electric
5	Honeywell
6	Xerox
7	GTE
8	RCA
9	Sperry Rand
10	Texas Instruments

The ELECTRONIC BUSINESS 100. *Industry leaders swap positions as they cope with slower growth.* (Page 37)

Electronic markets

Managing resources

Departments

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BPA ABP

Leadtime Forecast *(continued)*

solid tantalum leadtimes are longer than we like to see them, but we anticipate that they'll be coming in line within the next month or so."

However, that line might be a long one: Sprague reports 12- to 25-week delivery times for solid tantalums, eight to 15 weeks for wet tantalums and 12 to 15 weeks for foils; Mepco/Electra quotes 11 to 14 weeks for wet slugs, 12 to 14 weeks for wet foils and 14 weeks for chip and solid tantalum capacitors.

But at Newark, N.J.-based Cornell-Dubilier, director of marketing Art Jenkins says demand is easing somewhat, and he expects 16-week leadtimes to hold steady. Kemet's Roper, also noting some leveling off in demand, says his 16- to 18-week leadtimes for solid tantalums might fall two to four weeks by the second quarter.

Mica supply meets demand

When ElMenco, with 35 to 40 percent of the mica market, went out of business over a year ago, the supply/demand imbalance blew up, says Ralph Alter, product marketing manager at Pickens, S.C.-based Sangamo/Weston, Inc. Nevertheless, after a year of hard running to catch up, suppliers are making headway, says Alter, adding that stock to 24-week leadtimes will drop to 12 to 16 weeks by the end of the first quarter.

Likewise, Cornell-Dubilier's delivery times are on the way down. Jenkins, noting that "the gap is closing fast," says his 20-week leadtimes should fall to eight weeks within six months.

Film deliveries steady

"There's not much happening in this market," says Jaco's Kammann, reporting the same leadtimes as Cornell-Dubilier's—six to eight weeks and stable.

Siemens and Mepco/Electra quote longer though steady delivery times of from stock to 16 weeks and 12 to 20 weeks, respectively, despite what Epand terms "some softening in consumer markets like home appliances and television."

And Sprague, which straddles the leadtime range, reports film capacitor leadtimes of six weeks for commercial/industrial types and 25 weeks for military ones.

No problem with paper leadtimes

Some paper capacitor makers say HV/AC, motor, compressor and microwave oven markets, feeling a recessionary pinch, are somewhat soft. Others, seeing no signs of a slowdown, say demand is strong. However, all report stable leadtimes.

John Seins, marketing manager at General Electric in Hudson Falls, N.Y., notes "very good demand" and says that with additional capacity, the eight- to 12-week leadtimes of a couple of months ago have fallen to six to 10 weeks. New Bedford, Mass.-based Aerovox, also upping capacity, intends to bring 10- to 12-week delivery times down to eight weeks, says marketing manager Jack Chmura.

Cornell-Dubilier's Jenkins, noting that the energy crisis has put a damper on demand from the air-conditioning market, says his eight-week leadtimes might also fall a little. And Mallory's Breidenbaugh, also citing "soft markets and seasonal dips in demand," says his six-week paper capacitor delivery times will hold steady. ■

Letters

Who were they?

On the inside cover of the supplement to the December 1979 issue of ELECTRONIC BUSINESS, "Electronic Business in the 1980s," the electronics executives pictured were not identified. They are, from the left, John Young, president of Hewlett-Packard (see "HP enters the market for microprocessor development systems," ELECTRONIC BUSINESS, September 1979, page 71); Bob Burnett, assistant general manager, TRW Defense and Space Systems Group ("Electronic systems hold key to stretching military budgets of the 1980s," September 1979, page 48); and Walter Light, president of Northern Telecom ("Northern Telecom is rapidly moving south," January 1979, page 70).

By any other name

Your article in the November issue of ELECTRONIC BUSINESS, "Mini Winchester disk drives rush to the OEM market" (page 89), continues a misnomer in the digital disk world. "Merlin" was the code for IBM's Model 3330 announced about 1970. It has a ceramic slider, flies in the 100-microinch range and unloads to remove the 14-inch disk pack.

"Winchester" was the code for IBM's Model 3340 (not 3350) announced about 1973, a significant technology change over Merlin. Winchester has an all-ferrite slider that flies in the 20-microinch range and stops (lands) on 14-inch lubricated disks. A pack of disks plus the associated head/carriage constitute a head/disk assembly (HDA) that is user removable.

"Madrid" was the code for IBM's Model 3350 announced about 1975. An evolution from the Winchester, Madrid offered increased data density that necessitated making the HDA non-user removable.

"Piccolo" was the code name for IBM's Model 3310 announced about 1978. An evolution from Madrid, Piccolo reduced the disk diameter to 8 inches and scaled down the entire drive dimensions.

Thus "Winchester technology" should refer to the ferrite slider, 20-microinch flying height family of products available since 1974. The Fixed HDA products belong to the evolution of Winchester technology, which should be "Madrid technology"—available since 1976.

Bruce Petrarca
engineering supervisor
Digital Equipment Corp.
Natick, Mass.

No infringement

The article in the September 1979 issue of ELECTRONIC BUSINESS entitled "Backplane market grows despite controversy" (page 108) gives the erroneous impression that the AMP compliant pin infringes Elfab patents. This is contrary to the position Elfab has taken in litigation proceedings. While identifying other manufacturers as infringers, Elfab has specifically refused to accuse AMP Incorporated of infringement.

At one point, AMP filed a motion in the Elfab v. Elco suit, requesting permission to enter the suit to defend against the implication that AMP products infringed the Elfab patents. The court refused AMP permission to do so. Perhaps Elfab's reluctance to charge AMP with patent infringement stems from the fact that the evidence clearly shows that the AMP pin was invented long before the Elfab pin.

William J. Keating
general patent counsel
AMP Incorporated
Harrisburg, Pa.

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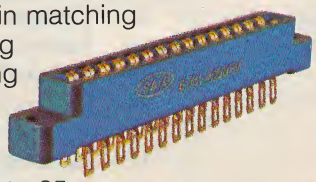

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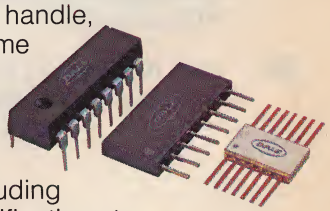

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Leadtime Index

PASSIVE COMPONENTS

PRODUCT	LEADTIME IN WEEKS Min.	Max.	Trend
*CAPACITORS			
Ceramic, disc	12	16	=
Ceramic, monolithic	13	18	=
Electrolytic, aluminum	10	20	↓
Electrolytic, tantalum	15	27	=
Film	7	12	=
Mica	17	25	=
Paper	9	15	=
Trimming	7	15	=
CRYSTALS, FILTERS AND NETWORKS			
Filter, active	16	20	=
Filter, EMI	16	21	=
Filter, lumped-constant	16	20	=
Filter, quartz (monolithic)	15	19	=
Freq. determining crystal	12	19	↓
ENCLOSURES			
Custom	8	12	=
Modified standard	9	17	up
Standard	5	8	=
FANS AND BLOWERS	20	44	=
FRACTIONAL HP MOTORS	10	25	=
INDUCTIVE COMPONENTS			
Coil	8	12	=
Solenoid	6	8	↓
Transformer, power	13	21	↓
Transformer, other	12	20	↓
INTERCONNECTION COMPONENTS			
Back panel	8	13	=
Flat cable	13	26	up
Multipin circular high-density	30	40	=
Multipin circular standard	22	30	=
Packaging panel	5	8	=
PC, one-piece	10	18	↓
PC, two-piece	10	17	=
Rack and panel	12	17	=
RF coaxial	18	29	=
Socket	5	10	=
PRINTED CIRCUITS			
Double-sided	10	15	=
Flexible	10	19	=
Multilayer	12	15	=
Single-sided	6	10	=

	LEADTIME IN WEEKS Min.	Max.	Trend
RELAYS AND TIMERS			
Crystal can	12	20	=
General purpose	10	17	↓
Miniature (TO-5, square)	16	26	=
Reed, dry	7	10	=
Reed, mercury-wetted	9	11	=
Solid state	5	10	up
Telephone	7	12	=
Time delay and timer	12	15	up
RESISTORS, FIXED			
Carbon film	17	22	↓
Composition	8	20	=
Metal film	10	16	↓
Network	14	23	=
Wirewound	12	20	↓
RESISTORS, VARIABLE			
Pot, nonprecision WW	10	16	=
Pot, precision WW	6	14	=
Pot, nonprecision comp.	6	14	=
Pot, precision comp.	10	14	=
Trimmer, WW	8	10	=
Trimmer, comp.	6	18	=
SWITCHES AND KEYBOARDS			
Circuit breaker	16	26	up
Dual in-line	10	14	=
Keyboard and keyswitch	8	12	=
Lighted pushbutton	9	11	=
Pushbutton	6	8	=
Rotary	9	11	=
Snap action	4	8	=
Thumbwheel	4	7	=
Toggle	6	8	=
TRANSDUCERS			
Pressure	4	12	=
Temperature	6	10	=
WIRE AND CABLE			
Coaxial cable	7	11	=
Flat and ribbon cable	5	7	=
Hookup wire	6	13	=
Multiconductor cable	7	12	=

*For additional leadtime information in this product area, turn to the Leadtime Forecast.

ELECTRONIC BUSINESS' Leadtime Index for popular electronic components and subsystems is published monthly. The figures, supplied by a composite group of major manufacturers and OEMs, are typical times necessary to allocate manufacturing capacity to build and ship a medium-sized order for a moderately popular item. Trend represents change expected for next month.

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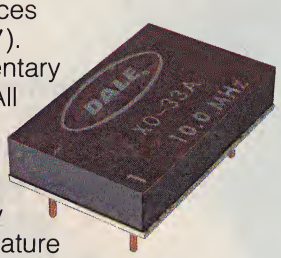

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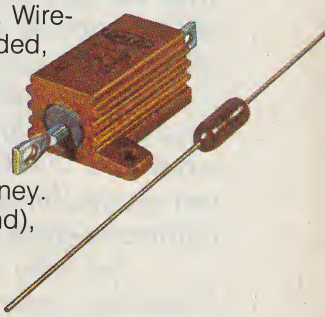

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Leadtime Index

February 1980

ACTIVE COMPONENTS

PRODUCT	LEADTIME IN WEEKS Min.	Max.	Trend
DISCRETE SEMICONDUCTORS			
Diode, switching	4	8	=
Diode, zener	4	9	=
Rectifier, low-power	4	6	=
Rectifier, power	1	4	=
Thyristor, low-power	6	10	up
Thyristor, power	7	16	=
Transistor, bipolar power	8	15	=
Transistor, bipolar signal	8	20	=
FET, power	8	20	▼
FET, signal	8	24	▼
Transistor, RF power	10	35	▼
DISPLAYS			
Fluorescent	8	12	=
Gas-discharge	3	12	=
Incandescent	14	19	=
LED	14	20	up
Liquid crystal	5	16	up
Plasma panel	8	16	=
ELECTRON TUBES			
CRT, black and white TV	7	12	=
CRT, color TV	5	9	=
CRT, industrial	8	17	=
Industrial power	13	25	=
Light and image sensing	4	7	=
Microwave power	15	20	=
INTEGRATED CIRCUITS, DIGITAL			
CMOS	16	36	=
Diode transistor logic (DTL)	12	20	=
Emitter-coupled logic (ECL)	12	20	=
Low power Schottky TTL	32	52	=
Standard Schottky TTL	28	40	up
Standard TTL	22	36	up
INTEGRATED CIRCUITS, LINEAR			
Communications circuit	16	28	=
Data converter	10	21	=
Interface circuit	8	15	up
Operational amplifier	9	19	=
Voltage regulator	10	20	=

PRODUCT	LEADTIME IN WEEKS Min.	Max.	Trend
MEMORY CIRCUITS			
EPROM	7	15	▼
PROM, bipolar	20	36	=
RAM, bipolar	7	16	=
RAM, CMOS	6	9	=
RAM, 4k MOS dynamic	10	14	=
RAM, 16k MOS dynamic	18	27	=
RAM, 1k MOS static	8	16	=
RAM, 4k MOS static	8	14	=
ROM, masked MOS	15	18	=
MICROCOMPUTER/MEMORY SYSTEMS			
Core memory board	8	12	=
IC memory board	6	12	=
Interface board	9	17	=
Microcomputer board	7	12	=
MICROPROCESSOR IC'S			
CPU, bipolar bit slice	6	17	=
CPU, 4-bit MOS	9	18	=
CPU, 8-bit MOS	13	20	=
CPU, 16-bit MOS	8	14	=
Peripheral chip	9	18	=
OPTOELECTRONIC DEVICES			
Coupler and isolator	4	10	=
Discrete light-emitting diode	4	13	=
PACKAGED FUNCTIONS			
Amplifier, instrumentation	8	11	=
Amplifier, operational	8	12	=
Amplifier, sample/hold	4	13	=
Converter, analog/digital	6	12	=
Converter, digital/analog	7	12	=
PANEL METERS			
Analog	14	27	=
Digital	15	23	=
POWER SUPPLIES			
Custom	14	27	=
Enclosed modular	10	16	up
Open-frame module	14	21	up
Printed circuit	12	16	=

Notice to component manufacturers and OEMs: If you wish to participate in our Leadtime Index, please send your name, title, company and address to: Leadtime Index, ELECTRONIC BUSINESS, 221 Columbus Avenue, Boston, Mass. 02116. Be sure to list the products of which you are a major manufacturer or user.

A sub

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And with the largest capacitor inventory in the country, National Capacitor is your best source for off-the-shelf delivery. Add to that the best technical knowledge available and the most experienced sales staff. When you back this up with an advanced communication network and a computer capability—it all spells "National Capacitor Supply." That explains why we can give the kind of fast service and quick answers no one else can offer.

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In solid-electrolyte tantalums we now offer the following:

MIL Style	Mallory Type	Life Failure Rates
CSR 13	TER	M, P, R
CSR 23	TXE	M, P
CSR 33	TXR	M
CSR 91	TNR	M, P, R

In non-solid (wet) tantalums:

MIL Style	Mallory Type	Life Failure Rates
CLR 10	XTM-XTK	L, M, P
CLR 14	XTL-XTH	L, M, P
CLR 17	XTV	L, M, P
CLR 65	TLX	L, M, P, R
CLR 69	TXX	L, M, P

All of these capacitors are available through authorized Mallory distributors.

For complete specifications in our new QPL bulletin, contact Mallory Capacitor Company, a division of Mallory Components Group, Emhart Industries, Inc., P.O. Box 372, Indianapolis, IN 46206. (317) 636-5353.

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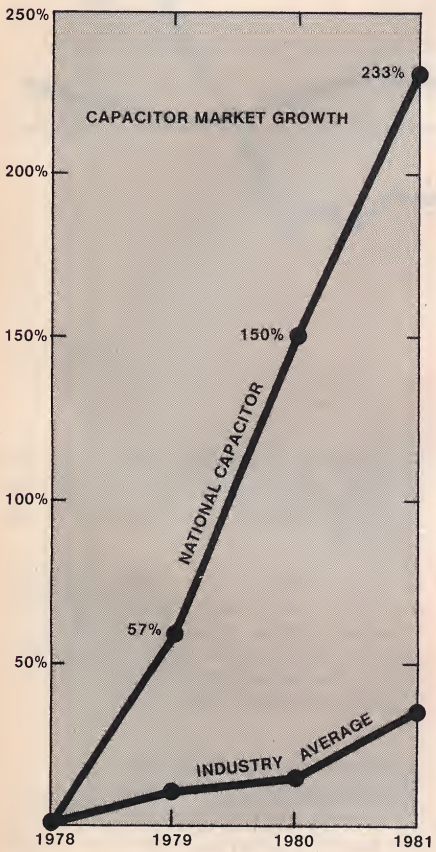
MALLORY

Growth In Capacitors Seen In 1980's



Martin B. Hartstein, chief executive officer of National Capacitor Supply, was one of the executives invited to attend the Electronic Business "Outlook 1980" meeting. The two-day planning conference was restricted to leaders from a cross-section of the electronics industry.

Mr. Hartstein stated that the mood of the meeting was optimistic. He said that the first speaker, John DeWolf, vice president of corporate research for Cahners Publishing Company, told of a 10% market growth for capacitors in 1979, and predicted a 4% growth for 1980 and a substantial 20% growth by 1981. This means that the capacitor market would experience a total growth of 34% in the period from 1978 through 1981.

In reviewing the Outlook Meeting, Mr. Hartstein noted that the commercial, industrial, and military capacitor market segments are forecasting growth for 1980. However, the consumer segment seemed to be headed for a slight decline, according to the Cahners market researchers. The greatest growth area appears to be in the industrial market with monolithic ceramics up 14% and with tantalum and aluminum electrolytic close behind with 13% and 11% respectively.

Mr. Hartstein pointed out that the total market growth figures are important because they set the business climate in which any company must operate. However, he agreed with the luncheon speaker, Bruce Henderson of the Boston Consulting Group, who stated that "a company growing faster than its competitors will eventually surpass its competitors."

"Consequently," Mr. Hartstein said, "it is the goal of National Capacitor Supply to continue to grow at a much greater rate than the market."

"We are continuing to grow at a phenomenal growth rate," Mr. Hartstein concluded, "and we have achieved this growth by offering our customers more than our competitors offer. We offer more capacitor inventory. More technical assistance, and faster, dependable delivery. More of everything our customer wants and expects from a distributor. Therefore, our growth will be far in excess of the predicted industry average."

Distributor Reduces Prices On Selected Capacitors

Steve Binnix, vice president and general manager of National Capacitor Supply, has announced price reductions on selected tantalum, electrolytic, ceramic and film capacitors. "The price discounts will be substantial on these capacitors," Mr. Binnix stated. "We're offering the discounts because we are overstocked in these areas.

"Consequently, we want to move 'em out," explained Mr. Binnix, "and we have prepared an overstock list for our inside sales desk. The list will be revised weekly until we are in a more comfortable inventory position on those items.

"Because we are compiling a new list weekly," Mr. Binnix said, "I suggest that our customers keep in close contact with our order desk. This way our customers can remain up-to-date on which items we are discounting."

Asked how much money his customers can save, Mr. Binnix responded, "The sales desk will quote the normal prices less a substantial discount, depending on the quantity desired."

National Capacitor Adds Two New Reps – AdTek Inc. And Houck Associates

National Capacitor Supply has recently signed Houck Associates and AdTek as two new distributor representatives, according to an announcement by Richard Fried, marketing manager.

Houck Associates, headquartered in Lutherville, Maryland, is now responsible for sales activities for National Capacitor in the states of Maryland, Virginia, and Washington D.C. AdTek Inc., located in Glendale, Arizona, is responsible for capacitor sales in Arizona and New Mexico.

Mr. Fried noted that the signing of these two representatives is part of an overall, national growth plan now in progress at National Capacitor.

Steve Binnix Appointed Vice President And General Manager Of National Capacitor

Steve Binnix has been promoted to vice president and general manager of National Capacitor Supply, according to an announcement made by chief executive Martin B. Hartstein.

Mr. Binnix has been an integral part of National Capacitor since 1976. In his new position, Mr. Binnix assumes responsibility for all phases of operations for National Capacitor Supply, and reports directly to corporate.

Mr. Hartstein noted, "Mr. Binnix is a talented professional, who has contributed much to earn his present position. I'm sure as vice president and general manager, Mr. Binnix will further strengthen National Capacitor's executive body.

National Capacitor Supply, located in Garden Grove, California, is a major capacitor distributor serving the entire nation.

Capacitor leadtimes level off

Capacitor leadtimes now average 14 to 15 weeks. By mid-year they're expected to fall slightly to the 11- to 12-week average reported throughout most of 1979. In 1981 they'll gradually climb back to current levels.

Disk makers dig in

"Everyone's dropping ceramic disk production to make items with higher profit margins, like monolithics," says George A. Beylouny, vice president and general manager for Mu-Rata in Marietta, Ga.

"Distribution is skyrocketing, and there's excellent demand from all market segments—mobile communications, automotive, EDP and business equipment," he points out, adding that use of nickel-electrode technology will cut costs and capacity increases will hold leadtimes at 12 to 14 weeks.

Jaco Electronics, with 16- to 18-week delivery times for ceramic disk capacitors, also attributes the crunch to strong demand and a dwindling supplier base. "Production lines are jammed with more lucrative products," says Carl Kammann, product manager for the Hauppauge, N.Y.-based distributor. He predicts that leadtimes will stretch at least two weeks in the first quarter.

That lengthening could impact users like Veeco Lambda, Melville, N.Y., faced with 18-week leadtimes for ceramic disk capacitors. However, there is somewhere to turn for speedy deliveries: Scottsdale, Ariz.-based Siemens is building inventory and has the items in stock, says capacitor marketing manager Don Epand.

Siemens also has ceramic monolithic capacitors in stock. And despite heavy demand made heavier as some customers switch over from hard-to-get micas, it will hold the line on leadtimes with additional capacity, he says.

Other manufacturers with longer delivery times are also holding the line despite soaring silver and palladium prices, booming markets and price wars.

According to Jerry T. Justus, vice president of marketing at Bridgeport, Conn.-based Vitramon, "the growth of hybridization in the U.S. and Europe, the worldwide upgrading of telecommunications systems to solid state circuitry and the increasing use of electronics by auto makers" are boosting demand for monolithic ceramic capacitors.

Nevertheless, the company's upping capacity as fast as possible, and ceramic chip leadtimes, which range from stock to 12 to 14 weeks, will remain stable, says Justus.

Kemet/Union Carbide in Greenville, S.C., also reports 12- to 14-week delivery times and heavy demand. However, says national marketing manager Tom Roper, the firm's leadtimes should fall a couple of weeks as extra capacity comes on line.

Like Vitramon and Kemet, AVX Ceramics in Myrtle Beach, S.C., not only faces strong demand but rising palladium and silver prices as well. And like its competitors, it's turning to increased automation, additional capacity and more cost-effective manufacturing processes to keep its prices level and its leadtimes between stock and eight weeks, says John Makhijani, vice president of marketing.

Stable electrolytic leadtimes

Manufacturers of electrolytic aluminum capacitors report steadily growing demand from telecommunications, data processing and instrumentation markets and fairly short, stable leadtimes ranging from stock to 22 weeks.

Although Sprague's ceramic disk capacitor deliveries take longer than most other suppliers'—20 to 26 weeks for single units and longer for duals—its leadtimes for computer-grade electrolytic aluminum capacitors are a short eight weeks. But delivery times of high-quality, smaller units are 22 weeks, says a spokesman for the North Adams, Mass.-based firm.

Other manufacturers report similar figures: Mallory Capacitor in Indianapolis quotes six- to eight-week leadtimes for standard units; Siemens, stock to 16 weeks for both standard and subminiature capacitors; and Newark, N.J.-based Mepco/Electra, six to eight weeks for tubular styles and six to 14 weeks for computer-grade capacitors.

Like Jaco Electronics with eight- to 10-week leadtimes for computer-grade devices and 10- to 12-week delivery times for axial leaded capacitors, these firms expect leadtimes to remain steady.

Tantalum leadtimes take off

Although all's quiet on the electrolytic aluminum front, electrolytic tantalum leadtimes are seeing plenty of action.

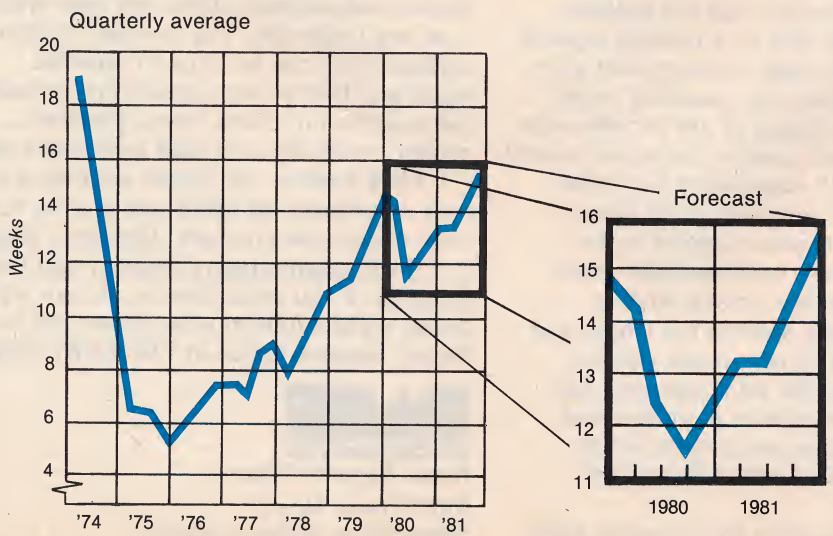
"Tantalum prices and leadtimes have gone haywire in the last year," says Mallory Capacitor's sales service manager Charles Breidenbaugh, who cites rampant tantalum powder price increases, 26-week delivery times for solid tantalums and 16-week leadtimes for wet tantalums.

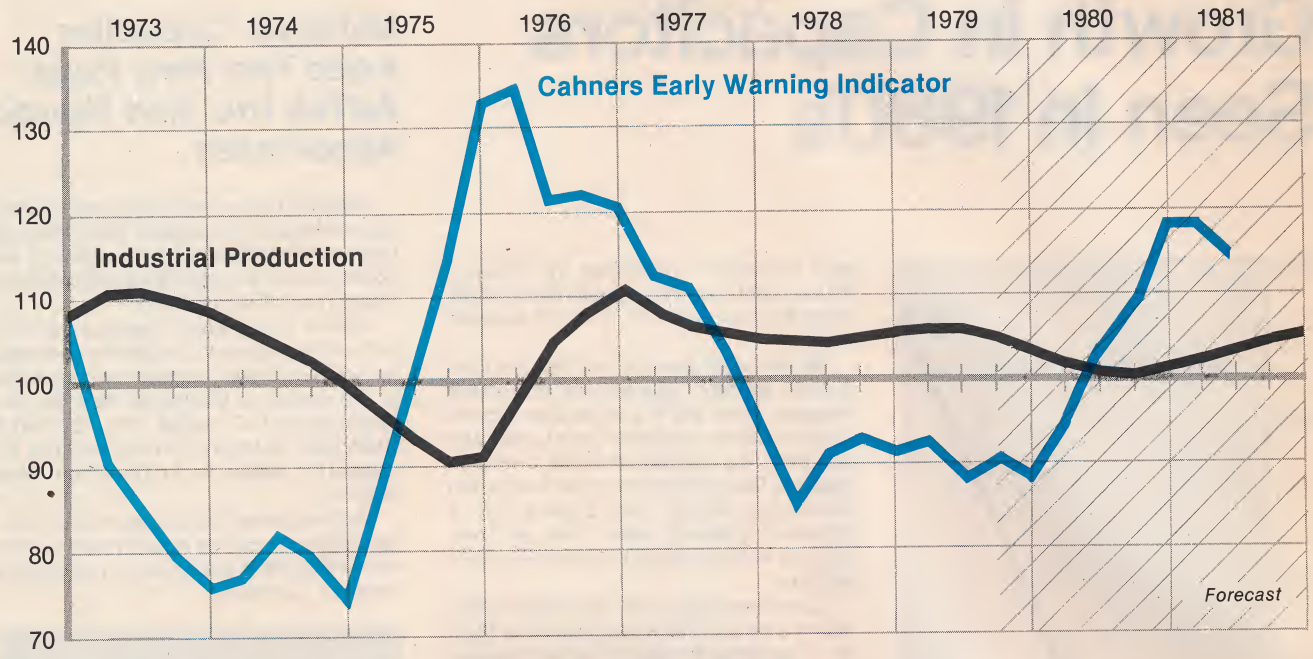
Like Breidenbaugh, Jaco product manager Al White thinks panic buying might be behind the surge in demand. Noting that 17- to 20-week solid tantalum leadtimes might hit 26 to 30 weeks, White says, "Tantalum powder shot from $20 a pound at the start of '79 to almost $200 a pound in December, and capacitor prices have jumped 50 to 60 percent over the past year."

Siemens' Epand, attributing the crunch to "an undercapacity problem and strong demand from computer, telecommunications and test instrumentation markets," thinks the extended leadtimes will improve shortly: "Our

Continued on page 146

Capacitor leadtimes





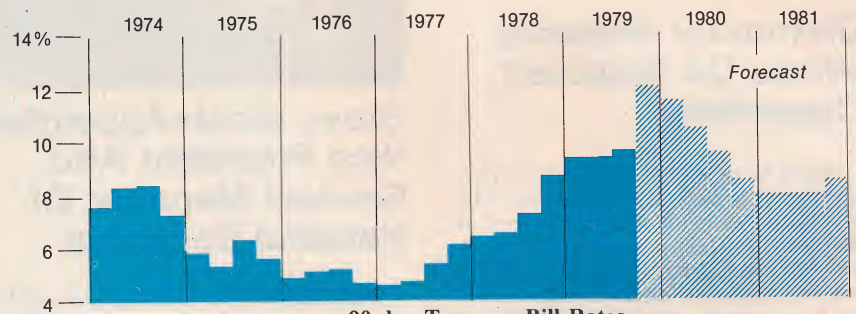
Cahners predicts an economic upturn in first half 1980

A coincident indicator of the economy, the U.S. Index of Industrial Production should continue to fall through the first quarter of this year. Its growth should resume by the second quarter of 1980 and continue through 1981.

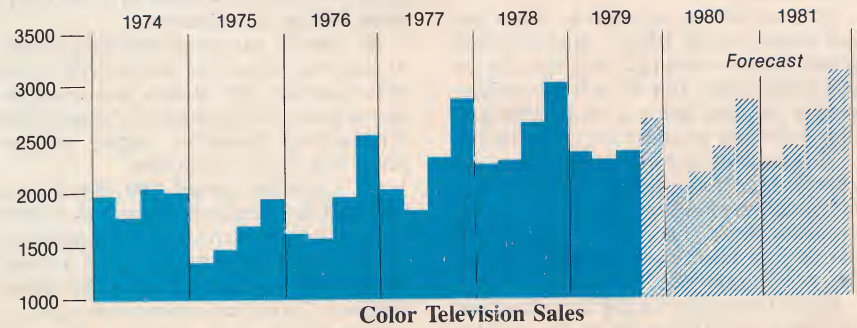
The Cahners Early Warning Indicator (CEWI) is a weighted average of housing starts, short-term interest rates and the Dow Jones Industrial Average. It forecasts probable business cycles about 12 months in advance.

The U.S. Index of Industrial Production (black curve) is indicated as a 12-month rate of change, which can be determined from the line at 100, and is forecast through 1981 using the CEWI. For example, the 100.6 level projected for the middle of this year indicates that the average of the 12-month period from mid-1979 to mid-1980 should be 0.6 percent above the average of the 12-month period from mid-1978 to mid-1979.

By John DeWolf, vice president, corporate research, and Cheryl Brown Patstone, economic analyst. Readers can obtain a brochure explaining the CEWI method from Cahners Economic Department, 221 Columbus Avenue, Boston, Mass. 02116.



90-day Treasury Bill Rates
(quarterly average)



Color Television Sales
(quarterly totals, thousands of units)

Treasury bill rates to decline

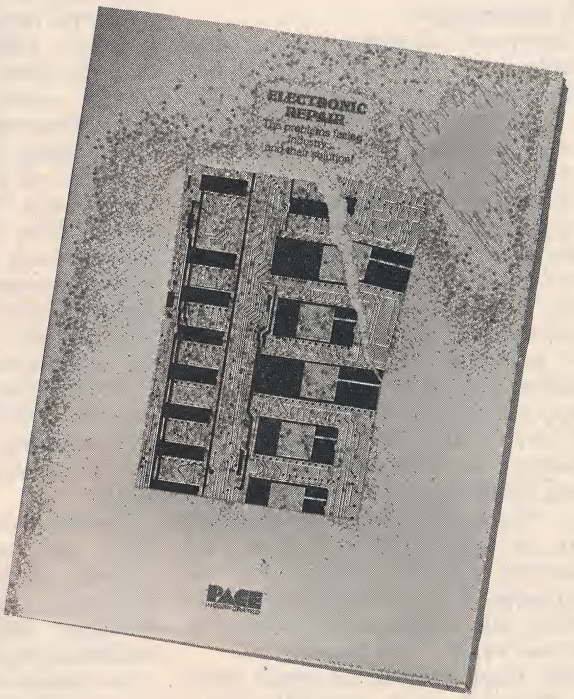
The yield on 90-day Treasury bills rose to an average of nearly 12.000 percent in the fourth quarter of 1979 from a 9.600 percent average in the preceding quarter. This jump resulted from the changes in Federal Reserve Board policy announced in October. Rates now appear to have peaked and are expected to decline gradually to 8.500 percent by year end. They should dip slightly lower next year but return to that level by December 1981.

Color TV sales down

Domestic market color television sales totaled 2.369 million units in the third quarter of 1979, off 10 percent from the 2.654 million units sold in the comparable period a year earlier. Sales from the fourth quarter of last year are expected to show a similar decline, and total 1979 sales should have fallen five percent from 1978's total. Another sluggish year is projected for 1980, with a 2.5 percent decline expected. For 1981, a gain of 11 percent to over 10.5 million units is forecast.

(Continued)

You Can Reduce Downtime, Pipelines, Floats, and the High Cost of Field Repair



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To counter the rising costs of field service, companies are constantly seeking more efficient means to quickly repair failed systems in the field. Many new portable diagnostic tools are now becoming available to permit rapid fault diagnosis down to the component level, even on site. However, diagnostics solves just half the problem. The boards must still be physically repaired. The full solution, really, requires that your personnel also have the capability to perform Full Board Repair at any location—in the factory, depot, service center, or on site!

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Plant Sites

Vitramon to build a 25,000-sq. ft. factory in West Germany

Vitramon, Inc., the Monroe, Conn.-based monolithic ceramic capacitor and semiconductor package producer, will build a two-story 25,000-sq. ft. factory in West Germany near Stuttgart with facilities for future expansion. The plant, which will be used to manufacture capacitors, is scheduled for completion by late 1980.

"The new plant demonstrates our commitment to offshore expansion and will strengthen our position in the corporation's fastest growing market," says president Barton L. Weller.

Vitramon crossed the $10,000,000 sales mark for the first time two years ago, and sales hit $9,476,000 during the first six months of this year.

Over the last two years, the firm doubled production in its Monroe plant, acquired QCI Corp. in Farmingdale, N.J., purchased a large tract of industrial property in Sao Paulo, Brazil, and leased a plant there, which began capacitor production last month.

■

Synertek, Santa Clara, Calif., will build a 160,000-sq. ft. manufacturing and engineering facility in Santa Cruz, Calif. Scheduled for completion in late 1980, it will employ 50 to 70 people initially and 375 within four years.

■

GenRad entered into a sale and purchase agreement for the acquisition of 87 acres of land in Littleton, Mass. It expects to start building a manufacturing facility at the site in 1981.

■

Priam Corp. moved into a 34,000-square foot plant in North San Jose, Calif. The facility, which includes a 4500-square foot clean room, will be used to assemble Winchester and Diskos drives. The firm expects volume to eventually reach 2000 drives a month.

■

Hi-Tek Corp.'s Keyboard Products Div. increased its Garden Grove, Calif., plant's size from 45,000 to 100,000 square feet by leasing an adjacent facility. According to George De Huff III, division vice president and general manager, rapid growth—50 percent for the last three years and an estimated 70 percent in '79—necessitated the expansion.

■

Prime Computer, Wellesley Hills, Mass., plans to move its headquarters and administration operations into the former Carling Brewery complex in Natick, Mass. Occupancy of the 457,000 sq. ft. of office space set on 35 acres is scheduled for 1983.

■

Comten, Inc. is building a $9.5 million, 236,000-sq. ft. facility in St. Paul, Minn. Occupancy of the new headquarters, which will house all operations but manufacturing, will begin late summer 1980.

■

IBM will add 423,000 sq. ft. to its semiconductor memory facilities in Esses Junction, Vt., at a cost of $22 million. About 150,000 sq. ft. will be for front-end processing of 64k RAMs.

■

Ann Arbor Terminals, Inc. moved its engineering and administrative departments into a 10,000-square foot building in Ann Arbor, Mich. In addition, it's building a 20,000-square foot manufacturing facility at the same location that will double its capacity.

■

TEK-Com, Inc. moved its corporate headquarters from a 7500-sq. ft. facility in Sunnyvale, Calif., to a 15,000-sq. ft. one in San Jose. This is the company's third expansion and move in less than three years.

■

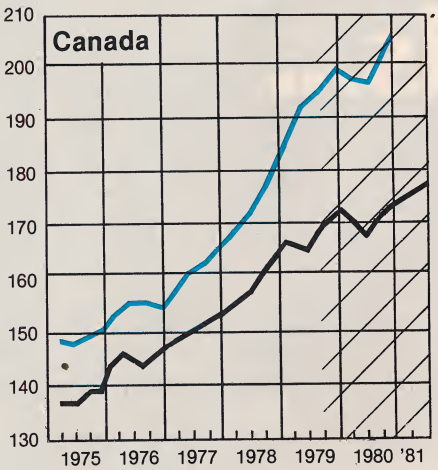
Aehr Test Systems, a burn-in test system maker, moved into a 12,000-square foot facility in Menlo Park, Calif. More than four times the size of the firm's previous facility in Redwood City, the building houses executive offices, an engineering department and manufacturing facilities. ■

Business Barometer

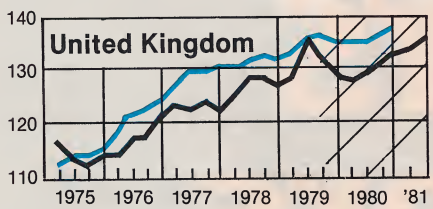
Overseas growth rates to pick up, inflation slow

Composite Leading Indicators (1967 = 100)

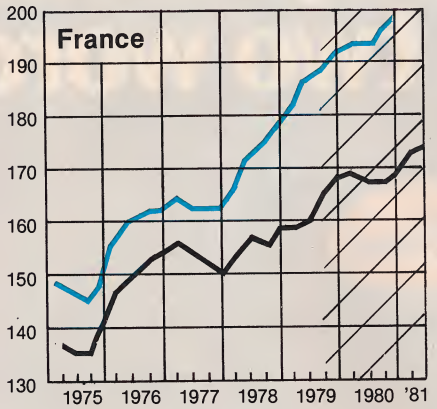
Industrial Production (1967 = 100)



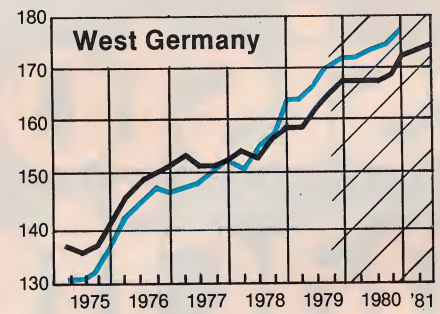
Canadian economic comeback expected
Canada's dependence on U.S. markets for its exports determines roughly 17 percent of its GNP. In addition, in order to manage capital flows, its interest rates are closely linked to U.S. rates and are therefore not likely to start declining until U.S. rates do. These ties to the U.S. limit the flexibility of Canada's government to deal with slowdowns and virtually ensure a business cycle synchronized with that of the U.S. As a result, industrial output is expected to climb 1.5 to 2.0 percent this year, down from 5.5 percent in 1979. In 1981, however, production should be up a strong five percent.



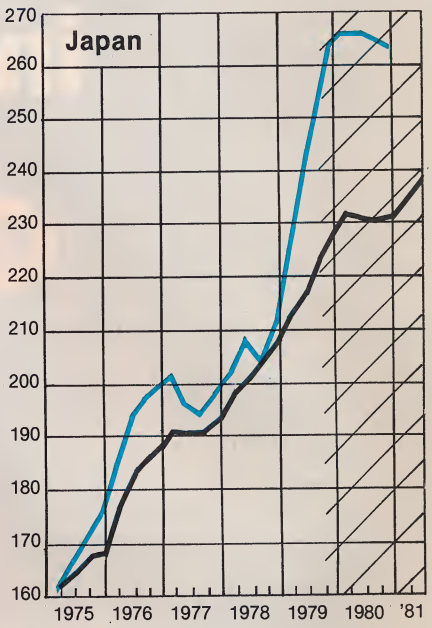
U.K.'s inflation rate to fall
By mid-1980, England's inflation rate should begin to decline. But for the year, consumer prices will average 18 percent above 1979's levels. The projected rate-of-change curve indicates a continued decline through 1981, bringing the year's average back to 11 to 12 percent. As a result, interest rates should decline over the period and help stimulate capital spending. Industrial output, after falling one percent this year, should rise a sharp four percent in 1981.



France's Barre Plan on the line
Last year, France's manufacturing sector might have begun to show the first positive results of the Barre Plan. Industrial production rose 4.5 percent, up from 2.2 percent in 1978 and 1.4 percent in 1977. In 1980, a crucial year for both the plan and Giscard, who faces an election in 1981, production is projected to level out during the second and third quarters. However, the year will average a three percent gain. Consumer prices, which rose 10.5 percent in 1979, are expected to increase only slightly more this year, about 11.5 percent. In 1981 they'll probably drop back to 10 percent.



Slower growth for Germany
West Germany's economy should experience slower growth but no recession in 1980. Industrial production should rise nearly three percent, compared with five percent in 1979. The construction sector, accounting for roughly 16 percent of GNP, and the auto industry, which has been booming for the last five years, both traditionally reflect the business cycle and are expected to show slower growth this year. The rate of consumer price inflation, which is heavily influenced by import prices, is expected to average 5 to 5.5 percent in 1980. It will decline to four percent in 1981.



Japan's budget deficit to grow
Japan's industrial output is expected to rise nearly five percent this year, giving it the highest growth rate of the industrialized countries. However, this rate is down from 8.5 percent in 1979 and masks a leveling out during the last three quarters. Consumer prices are expected to rise 8.5 percent in 1980, up sharply from 3.5 percent in 1979, partially as a result of the enormous increase in the government's deficit and the sharp rise in world oil prices.

Industrial production data and Treasury bill rates are from the U.S. Commerce Department. Color television sales figures were supplied by the Electronic Industries Association, and composite leading indicator data were provided by the Center for International Business Cycle Research, Rutgers University. Forecasts were based on the CEWI.

Establishing local field repair depots can shorten the replacement pipeline and reduce float inventory.

product design engineering manager at the Westboro, Mass., facility, says his firm has adopted board swapping as its repair philosophy because it's the quickest way to get a system back into operation. Defective boards are either shipped back to a field engineering repair center, to a regional repair center, or fixed in the field engineer's office.

Murdock says the approach taken usually involves a cost trade-off. High volume, low cost boards are usually repaired at the office, while lower volume, higher cost boards go to major regional repair centers. Boards not easily fixed in the office are usually sent to the field engineering repair center.

To reduce the pipeline associated with the major repair centers, Data General is looking more to the local centers for board repairs. Murdock estimates that for every board in the field there are three used for board swapping. By localizing repairs he hopes to cut down this inventory considerably.

But Murdock notes that important considerations here are efficiency and quality. He says customers want a board that looks factory-fresh and not butchered through improper repair procedures. Thus for the local engineer to do an effective job, according to Murdock, he needs professional and high quality board-repair equipment.

A universal repair philosophy

Pace is one of the largest suppliers of this kind of equipment. Its "universal repair" philosophy underlies the various systems the company offers.

Through portable, bench top and larger repair and rework systems, complete board maintenance can be achieved. Removing ICs, for instance, normally done with a soldering iron, various hand tools and some sort of solder removing device, can be accomplished in one operation. Multi-function adapters for even the least expensive equipment offered by Pace allow IC removal, solder removal through vacuum control, and probe temperature maintained at a safe level, which eliminates damage to potentially working components.

The Pace equipment not only lets components be reinstated in boards, but some systems also provide for repair and/or replacement of damaged or worn circuit board "lands," feed-through holes and finger connectors. Various models allow users to selectively replate lands and fingers with nickel, tin, copper and even gold.

Repairs to other equipment assemblies like terminal blocks, wires and multiconductor cables are all possible with optional accessories.

Complete board repair

Pace's Rosenthal believes these kinds of rework and repair systems will play a major role in allowing OEMs to effect high-quality repairs at the customer site and local repair center level. But more important, they will ensure quick and efficient complete repair, thereby reducing the pipeline effect and float inventory maintained by so many companies.

CDC's Lundquist says the Pace equipment has seen excellent application at his firm. "We do a professional, high quality repair and removal," he says, "and workmanship is a big part of the Pace station."

Tom Doyle, manager of field support engineering at Compugraphic Corp., North Reading, Mass., notes that his firm employs about 350 field service personnel worldwide, all of whom will eventually use this kind of equipment for repair work.

Compugraphic has traditionally returned boards to the factory for repair, but Doyle comments that other methods are now under consideration to hasten the process and reduce the spare-parts problem. Pace equipment and others like it could prove a very cost-effective approach to board repair in the field, he says.

More field depots coming

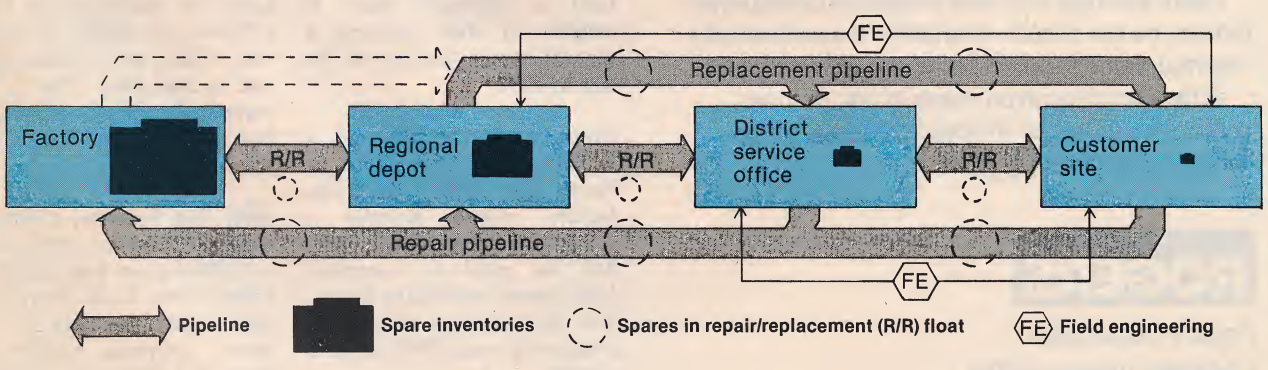
Within the next year or two, Doyle expects to have many intermediate field repair depots in operation to improve the productivity of Compugraphic's field service.

Digital Equipment Corp. uses Pace equipment extensively at its major repair centers in Woburn, Mass., the Netherlands and Hong Kong. Harold Long, a manager at Digital's field service department, is also looking at placing some variations of this equipment at smaller field repair depots.

"We see some opportunities in servicing specialized products at the local level," he says, "and we're experimenting with that concept now."

While Digital is aware of the pipeline problem, Long says it's simply a cost of doing business. Although he admits that large board inventories are an economic burden, he adds that with some products, local repair isn't effective. The level of sophistication needed to test and repair some of the highly complex boards that go into Digital's equipment can only be found at the factory. The alternative is to equip local repair sites with high-priced automatic test equipment, which Long notes doesn't make economic sense.—*J. Tsantes*

Logistics of board swapping



Source: Pace, Inc.

***Board swapping to** bring customers' equipment to full operation is very fast but plays a major role in the long-replacement pipeline effect that could last up to 12 months. Employing localized or district service centers can significantly reduce board turnaround time.*

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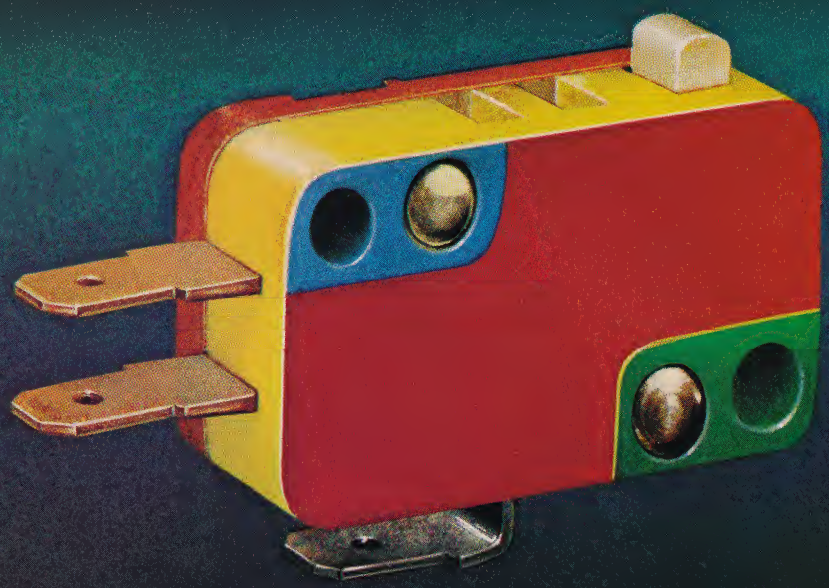

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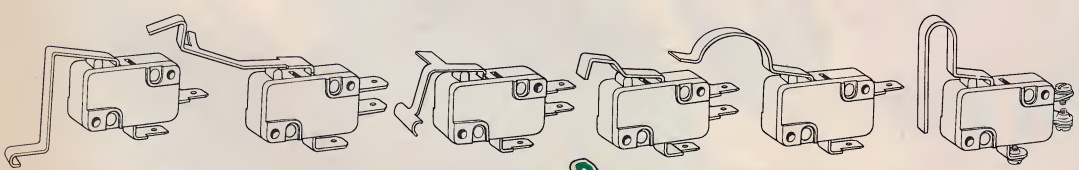

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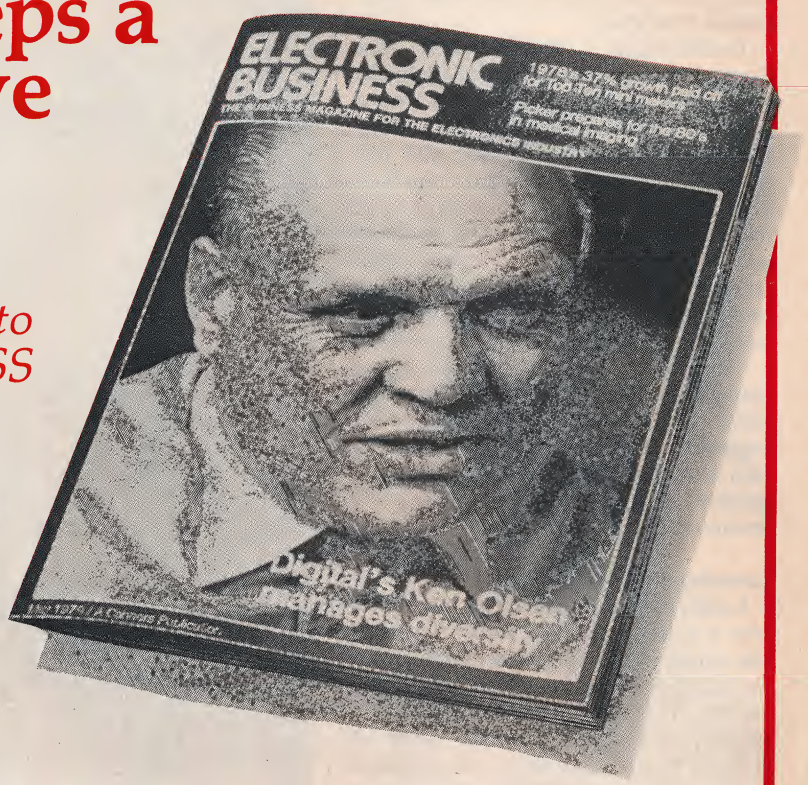

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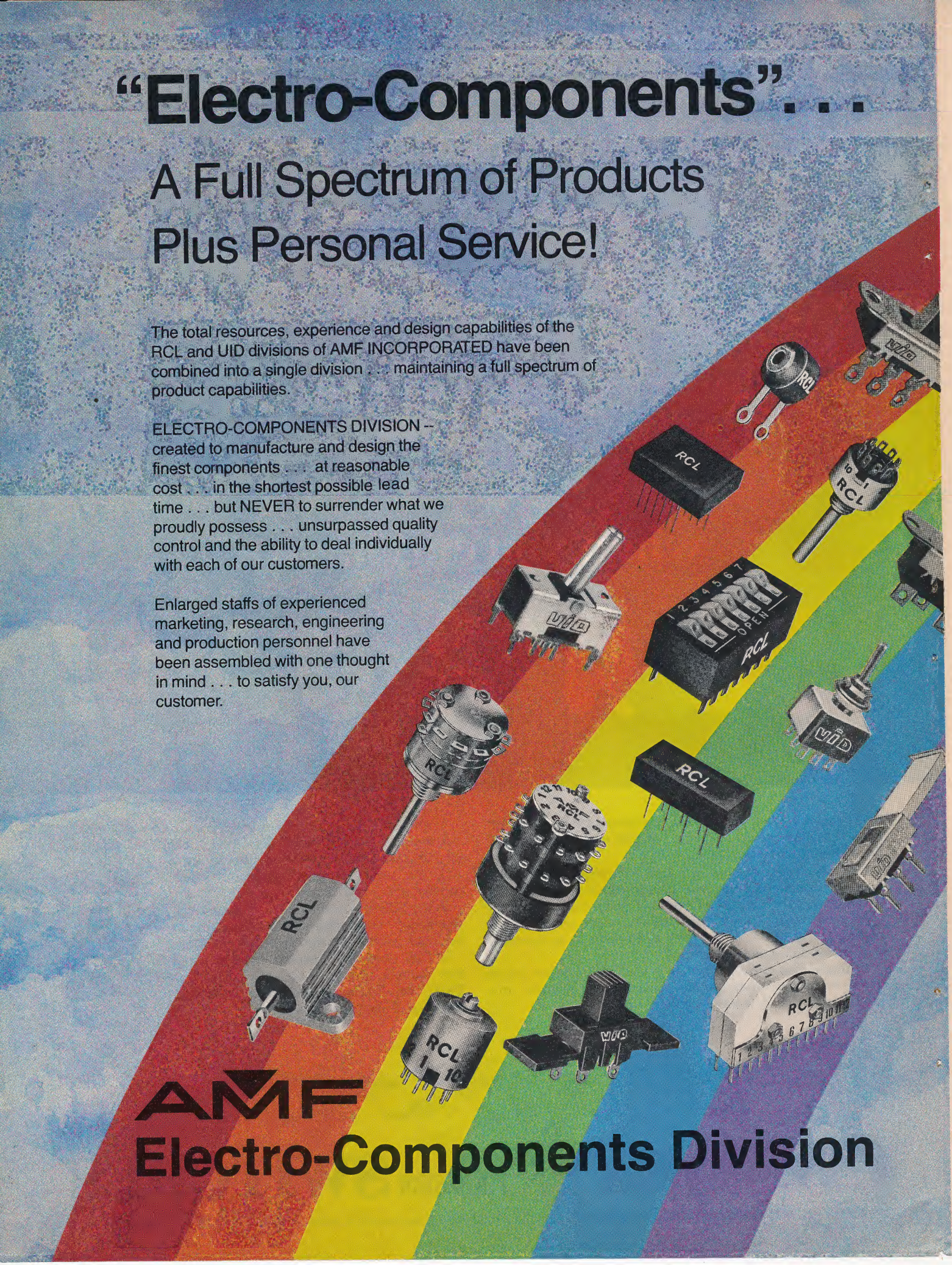

AMF

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thal's views on field repair and are paying much closer attention to the entire field service operation.

Traditionally, manufacturers like Control Data Corp. (CDC) relied on the customer-to-factory pipeline for board repairs, but according to Gary Lundquist, manager of repair and test development, the repair environment is beginning to change. Lundquist says there is increased emphasis on the field service department to do the repair rather than return defective boards to the factory where they could disrupt the production operation.

"When it can be done more cost-effectively," he says, "it makes more sense to have dedicated field engineers do the repair because they can turn around the board or assembly more quickly and reduce the spare-parts inventory."

Lowering field service costs

Lundquist notes that CDC has set up over a score of regional repair depots in this country and abroad in addition to a major repair center in its St. Paul, Minn., facility. He estimates that today about 65 percent of board repairs (in terms of dollars) are performed at the regional centers, whereas previously repairs were done almost exclusively at the factory.

But the major changes in CDC's repair procedures involve the company's philosophy. Repair planning is now done in the early stages of equipment design rather than as an afterthought. This philosophy, coupled with the setting up of regional repair depots, has allowed CDC to reduce its repair turnaround time from 60 to 90 days to one or two weeks.

At NCR Corp. in Dayton, Ohio, Chuck Frusterio, manager of field test system development, says board swapping, local repair depots, regional repair depots and factory board repair are all part of NCR's approach to field service. While he notes that finding and repairing faulty boards represents a large portion of field service costs, he maintains that the pipeline problem and float inventory are the major cost factors.

Frusterio says that eventually the only way to beat these costs is to get down to component level replacement at the customer's site. "We'll have to be able to do it almost as fast as it takes to do a board swap," he says.

Many "good" boards test "bad"

Customer-site repairs will not only reduce the float inventory and the pipeline effect, according to Frusterio, but also the number of "good" boards inadvertently thrown into the pipeline because of incorrect diagnosis. He says that anywhere from 30 to 70 percent of the boards returned to the factory at any one time can actually be "good."

Data General's Chuck Murdock,

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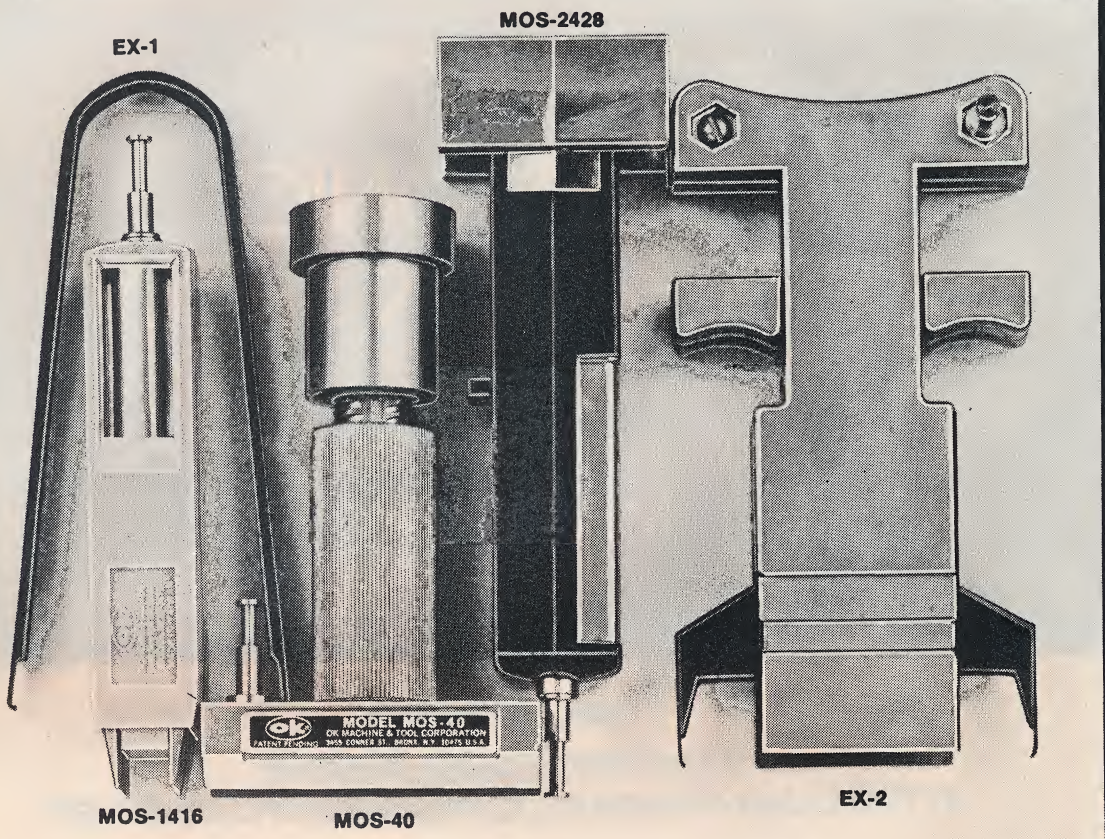

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Local board repair cuts inventory, boosts equipment profitability

Growing circuit board complexity and spiraling labor rates for field service personnel dramatically alter the concept of board repair.

The problems facing original equipment manufacturers' (OEMs) repair operations in servicing and maintaining field equipment are growing as fast as the complexity of that equipment. While diagnosing and repairing faulty printed circuit boards, for instance, was once a relatively simple task, today the advent of microminiaturization, LSI, increased board density and multilayered construction has dramatically changed the concept of repair.

Faced also with escalating labor rates for field service engineers and technicians, • equipment manufacturers are currently looking for more efficient and economic means to increase the productivity of the field and board repair operations within their companies and thus the profitability of the equipment itself.

According to Al Rosenthal, market development manager for Pace, Inc. in Silver Spring, Md., a manufacturer of board and assembly repair systems, repair involves first, problem diagnosis to isolate the cause of failure to a particular component or function on the circuit board, and second, "physical repair" to restore the board to its original performance and reliability characteristics.

A field engineer's ability to diagnose a fault quickly and efficiently rests on his understanding of equipment design and operation and the availability of adequate diagnostic tools. However, it's the company's procedure and policy for the actual repair of the board that has far-reaching effects on service costs and equipment profitability.

Industry sources estimate that over a billion dollars annually go into finding the 10 million integrated circuits that fail each year in the field. To get a system operating again once a faulty board is isolated, most equipment manufacturers rely on a "board swapping" approach. While this method quickly restores a customer's equipment to operation, it can create problems for OEMs.

Expense is a major one. Board swapping requires manufacturers to maintain large inventories of spare boards "floating" in the factory, in transit, or at regional depots for shipment to a customer site if a problem arises. Rosenthal says this approach can account for up to five percent of a manufacturer's assets tied up in spare module (float) inventory. In the computer and computer-related industry alone, some observers place this float inventory at one billion dollars.

Additionally, the replacement pipelines that must be maintained to move defective boards to and from customer sites and factory repair operations can further burden OEMs with shipping costs, extra personnel to keep the pipeline going and, more importantly, lost time: A circuit board can remain in this pipeline for three to six months and even as much as a year.

Reducing the pipeline effect

Many manufacturers are taking steps to eliminate or at least reduce their dependency on this pipeline and float inventory, and board-repair-system suppliers like Pace, Weller, Ungar and others maintain that the logical solution is to repair the boards wherever they're tested. Pace's Rosenthal notes that the key to maintenance/repair profitability and efficiency is to provide each field engineer with the ability to optimize or reduce board swapping, which could then dramatically shorten the board repair pipeline.

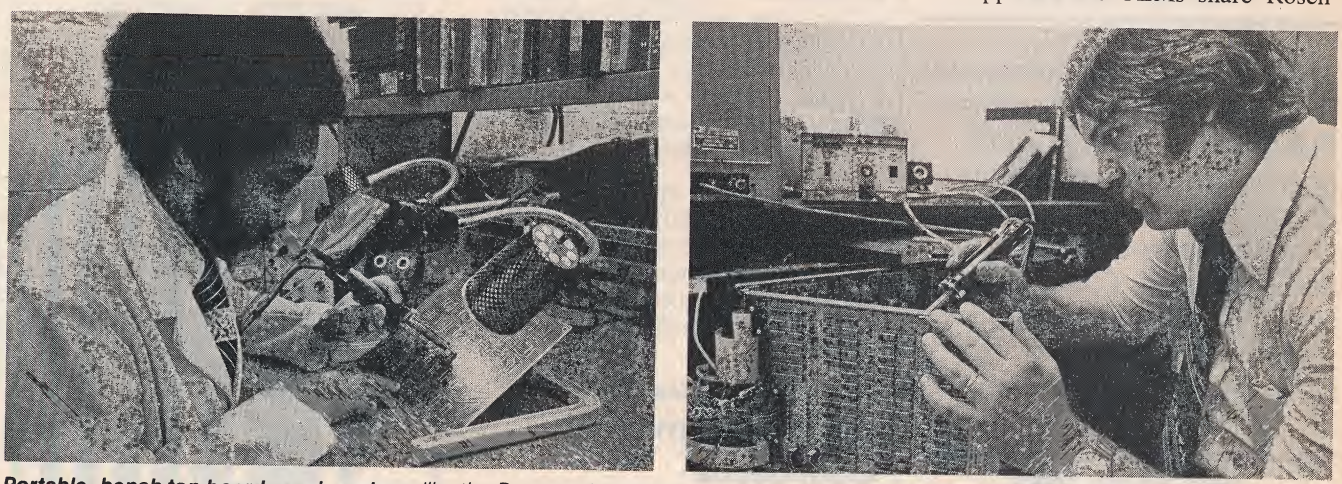
According to Rosenthal, repair can be effected either on-site or off-site. On-site repair offers the greatest potential dollar and time savings for a repair organization primarily because of the shorter pipeline required and reduced number of boards in the float system. As part of this approach repairs can be made either on-line or off-line. With on-line repair the board is pulled, repaired and then replaced into the system. Off-line repair, says Rosenthal, is a far more desirable method because it utilizes board swapping to immediately restore the system to operation, although it requires some level of inventory. The advantage is that once repaired, a board can be reinstalled to verify operation.

Off-site repair depends on board swapping as the primary method of maintenance and requires a full board inventory maintained either at the customer's site or carried by the field engineer. It also demands a continuously active pipeline to some remote repair activity, plus a float inventory at various stages of transit.

Rosenthal remarks that if off-site is the only logical approach for a repair operation, it's best to establish at least regional depot operations to shorten the pipeline costs back to the factory.

A changing environment

It appears that OEMs share Rosen-



Portable, bench top board-repair systems *like the Pace equipment shown here can allow very fast and high-quality rework of virtually any type of printed circuit board. ICs can be removed and reinstalled, circuit lands replaced, and even board fingers replated by the field engineer.*

Calendar

"Microwaves for Managers" Seminar, Feb. 11-12, Holiday Inn, Palo Alto, Calif.; March 13-14, Inn at the Park, Anaheim, Calif. (415) 493-4000 x2508. Enrichment Cassettes, Inc.

Southwestern Computer Conference, Feb. 19-21, Myriad Convention Center, Oklahoma City. (405) 947-4421. Oklahoma State University Technical Institute.

TechEx '80 (world fair for technology exchange), Feb. 19-22, World Congress Center, Atlanta; Feb. 26-29, Bella Center, Copenhagen; March 5-7, World Trade Center, Singapore. (904) 677-7033. Dr. Dvorkovitz & Assoc.

Compcon Spring 80 (computer conference), Feb. 25-28, Jack Tar Hotel, San Francisco. (301) 439-7007. IEEE.

Nepcon West '80 Exhibition, Feb. 26-28, Anaheim Convention Center, Calif. (312) 263-4866. *Electronic Packaging and Production, Semiconductor International* and the International Electronics Packaging Society.

"How to Forecast" Seminar (Cahners Early Warning Forecast), March 6, Registry Hotel, Irvine, Calif.; March 13, Hyatt Regency, Chicago. (617) 536-7780. Cahners Publishing Co.

Fifth West Coast Computer Faire/ Conference (for home, business & industry), March 14-16, San Francisco Civic Auditorium. (415) 851-7075. Computer Faire.

IECI '80 (industrial & control applications of microprocessors), March 17-19, Sheraton Hotel, Philadelphia. (617) 739-2022. IEEE/IECI.

Interface '80 (data communications exhibition), March 17-20, Miami Beach Center. (800) 225-4620; in Mass. (617) 879-4502. Datacomm Interface Group Conference and Exposition.

Design Technology 80 (for computers & datacomm systems), March 19-21, Disneyland Convention Center, Anaheim, Calif. (312) 263-4866. Industrial & Scientific Conference Management, Inc.

Minicomputers, DDP, Data Communications & Networks Conference, March 24-26, Shoreham Americana Hotel, Washington, D.C. (213) 450-0500. AIIE.

Energy Technology Conference/ Exposition, March 24-26, Sheraton Washington Hotel, Washington, D.C. (301) 656-1090. Government Institutes, Inc.

Powercon 7 (solid-state power conversion conference and exhibition), March 24-27, Town & Country Hotel, San Diego. (805) 985-6978. Power Concepts, Inc.

National Design Engineering Show/ Conference (computers, electronics & new materials), March 24-27, McCormick Place, Chicago. (212) 687-7730. Clapp & Poliak, Inc.

Invitational Computer Conference, March 25, Dallas Marriot. (714) 644-6037. B.J. Johnson & Assoc.

SSE '80 (Southwest Semiconductor Exposition), March 25-27, Phoenix Civic Plaza Convention Center. (408) 245-6870. Cartlidge & Assoc., Inc.

INTERNATIONAL

ERA Management Conference, March 1-7, Princess Hotel, Acapulco. (312) 649-1333. Electronic Representatives Association.

1980 National Office Exhibition/ Conference, March 10-12, Exhibition Place, Toronto. (416) 967-6200; in Canada 1-800-268-7108. Whitsed Publishing Ltd. & *ComputerData Magazine.*

Semicon Europa, March 11-13, Zuespa Convention Center, Zurich. (415) 964-5111. Semiconductor Equipment & Materials Institute, Inc. (SEMI).

Production & Inventory Control Equipment Exhibition, March 10-14, U.S. Commercial Office, Moscow. (202) 377-2460. Bureau of East West Trade Seminar/Exhibits.

Middle East Business Equipment Show, March 16-20, Bahrain Exhibition Centre, Manama, Bahrain. (800) 227-3477; in Calif. (415) 474-3000. Technology Marketing Analysis Corp.

Eurocon '80 (European conference on electrotechnics), March 24-28, Stuttgart, West Germany. (914) 945-1646. IEEE.

Salon International des Composants Electroniques, March 27- April 2, Parc des Expositions, Porte de Versailles, Paris. (202) 377-3371. U.S. Dept. of Commerce.

Communications 80 (equipment & systems), April 15-18, National Exhibition Centre, Birmingham, England. Savoy Place London WC2R OBL. Tony Davis Communications; IEE.

Agullo adds that there's no problem finding good production and technical people in the Commonwealth; only managers in quality control and materials are in short supply.

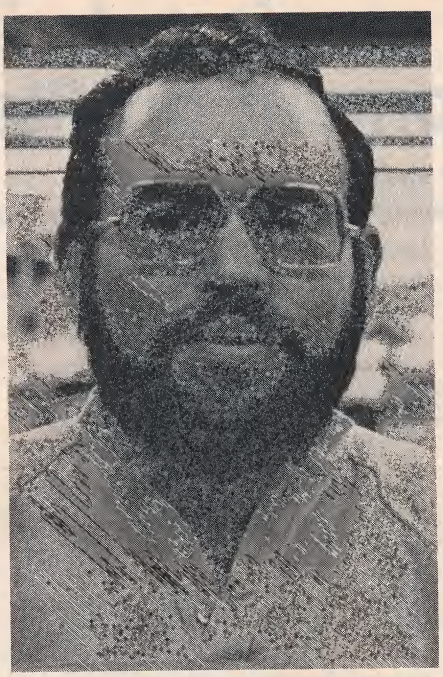
Beyond printwheels

One of the biggest success stories in Puerto Rico is Qume, in operation there only since May 1978 but already grown to 700 employees. The original purpose of the plant, says general manager Sergio R. Moren, was to produce printwheels and ribbon cartridges.

But after four months the facility was operating so well that it added printer production; Qume's two plants now produce about 50 percent of the company's daisy wheel printers, and Moren says that portion will eventually rise to 70 percent.

Unlike many Puerto Rican plants, Qume's handles marketing and materials acquisition. Moren doesn't expect product and development engineering to move to the facility, however. He says one problem in hiring engineers is that plants in Puerto Rico have to compete with mainland defense firms for engineering graduates from the University of Puerto Rico at Mayaguez.

Many of these firms need minority U.S. citizens, so they recruit heavily. Qume has therefore turned to Georgia Tech for engineering graduates. "We pay competitively but can't meet the offers from defense contractors who have to meet quotas," says Moren.



Qantel's Ramos: *"Productivity of workers is 20 percent higher than in California."*

Qume has expanded to fill the five buildings vacated when CB maker HY-Gain went bankrupt. It now occupies 109,000 square feet and will add 44,000 square feet more.

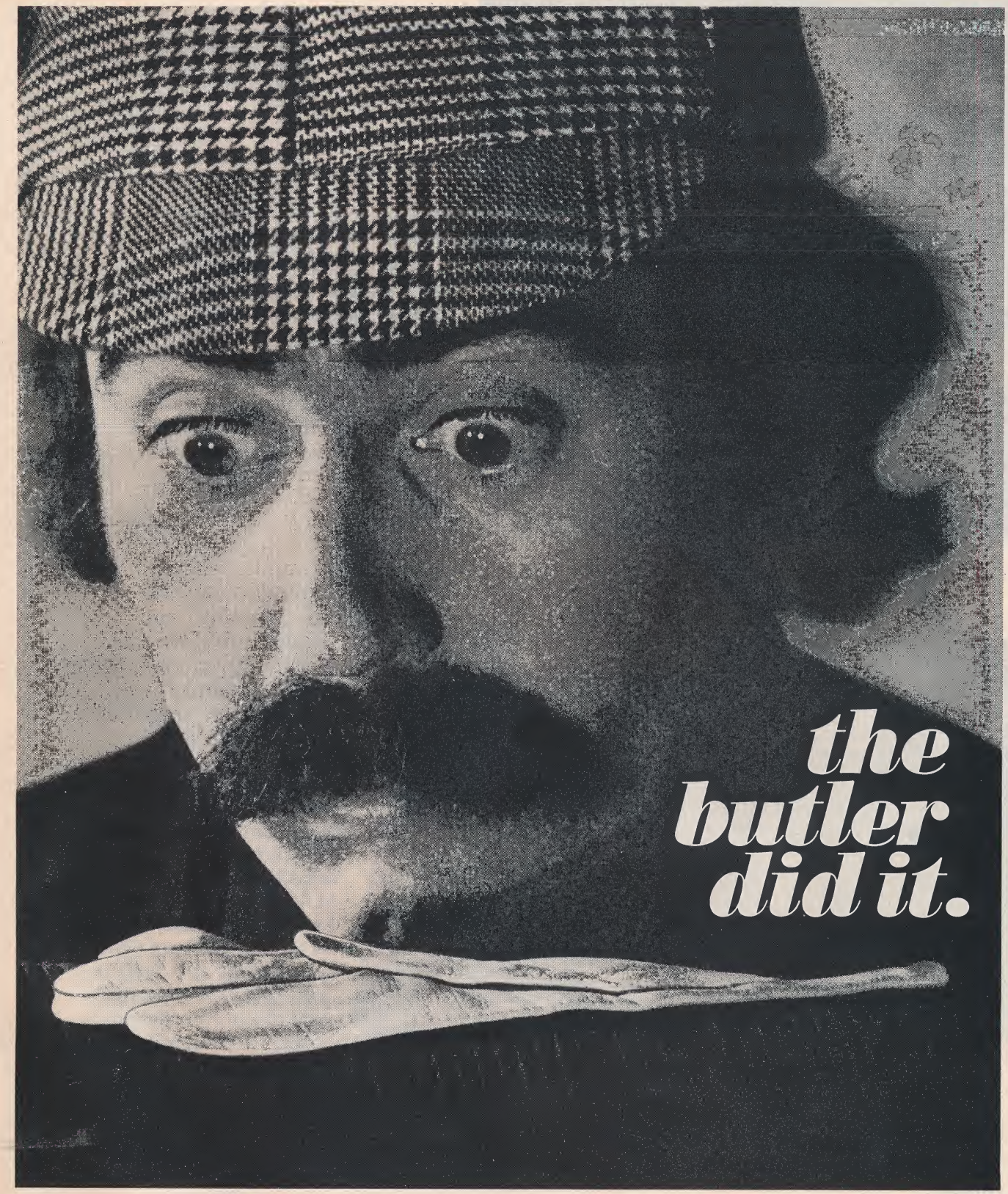
Another impressive new facility is that of small business computer maker Qantel. Its Juncos plant, in operation since March, occupies 23,000 square feet and houses 96 employees who produce finished circuit boards, CRT terminals, all memory systems and certain subassemblies for the company. The plant currently builds 25 percent of company output, says vice president and general manager Nicholas Ramos.

Qantel is adding 46,000 square feet to the facility. It will soon start building the firm's new Model 210 integrated computer system and another peripheral, which will boost the plant's output to 50 percent of the company's manufacturing volume by July.

Ramos claims productivity of his employees is 20 percent higher than of those in California. "Californians are very creative engineering people, but as manufacturers they stink," he says.

Ramos notes that the tax exemptions offered by the Federal and Commonwealth governments were major incentives for Qantel to come to Puerto Rico, but they don't keep firms there.

He has no problem finding skilled technicians, but he cites the mobility of executives as a growing concern. And Ramos should know, having formerly been general manager of Digital's large CPU plant in Aguadilla.—***P. Franson***



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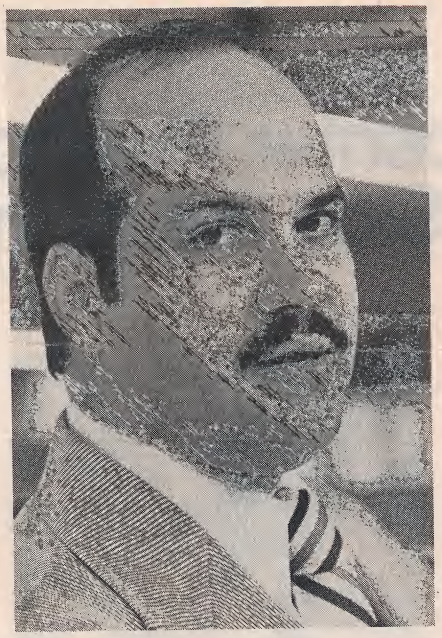
leased from the Puerto Rican Industrial Development Corp. (PRIDCO). The real estate arm of the Commonwealth government, according to Eugenio H. Fontanes, president and general manager, PRIDCO owns 20 million square feet in 860 buildings all over the island and is adding one million per year.

These plants range in size from 11,500 square feet to large custom buildings. The organization is now building 100,000-square foot buildings on speculation in some of the larger cities. Rental rates, which are graduated to encourage operation in less developed areas, range from $1 to $2 per square foot.

STC's plant, although it appears plain from the outside like most PRIDCO buildings, is modern and well-equipped. It contains three Universal Instrument inserters (two DIPs, one variable center), plus a sequencer, four GenRad 1795-B board testers, a Zehntel 400A in-circuit board tester and a Macrodata MD-207 memory system tester.

The firm also uses an IBM 370 for testing its plug-compatible disk controllers, and a very sophisticated wave soldering system.

Storage Technology's plant is better equipped than most other similarly sized facilities. Prime Computer, for example, also in Ponce, began operation at the same time as did STC's facility but currently employs only about 50 workers to produce finished and tested circuit boards. General manager Freddie Madera expects to hire 120 employees by the end of 1980, when the firm will add 23,000 square feet to double the plant's size.



Microdata's Agullo: *"There's no problem finding good technical and production people in Puerto Rico."*

Hopes for high volume

Another board-stuffing plant is Systems Engineering Laboratories in Humacao. It makes 80 percent of its parent company's boards, says plant manager John P. Arana. The operation is now adding materials planning and purchasing and will shortly start building an unannounced small computer that Systems hopes will hit high volume.

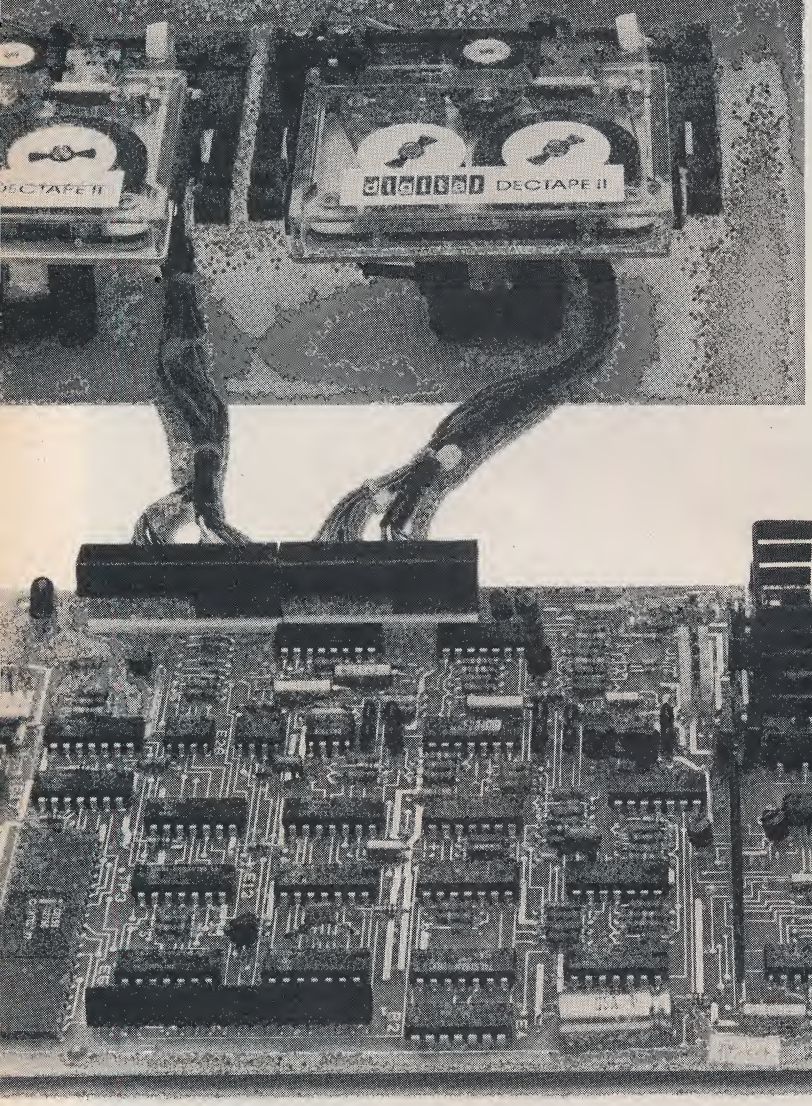
Microdata, which has a plant in the Carolina suburb of San Juan, makes complete peripherals, and its U.S.-based vice president of operations, George Olenick, thinks that companies that only assemble boards in Puerto Rico are overly cautious. "The only reason to be in Puerto Rico is for profits, and so the higher value the equipment built, the better." Microdata performs its low cost labor assembly operations in Barbados.

Olenick says he doesn't see any difference in Puerto Rico's productivity from that of Irvine, and he believes the technical capability and availability of assembly and test people is far better in Puerto Rico.

Microdata's plant manager, R.S. Agullo, is a native Puerto Rican who went to boarding school, got his bachelor's and master's degrees in electronic engineering and worked in the States. He notes, however, that Puerto Ricans who once lived on the mainland often don't readapt well to their island.

Introducing mass storage for micros.

It costs like a tape, but thinks like a disk.



The TU58 cartridge tape, single or dual drive. It's the first sensible answer to micro mass storage problems.

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In Europe: 12 av. des Morgines, 1213 Petit-Lancy/Geneva. In Canada: Digital Equipment of Canada, Ltd.

It took the minicomputer company to make micros this easy.

Digital's 512Kb TU58 cartridge tape subsystem. At $562 in 100's, it's priced like a tape device. But with random-access block addressing, and EIA serial interfacing, it's like no other tape drive on the market.

That's because the TU58's controller board has a built-in MPU that makes it think like a disk. It reads, writes and searches for data in blocks, instead of running serially through the whole tape like conventional systems. And the TU58's small size—the board measures just 5.2" x 10.4" (13.2 cm x 26.5 cm)—makes it easy to design into your product.

digital

Electronics center Puerto Rico sheds West Side Story image

The lovely island of Puerto Rico offers a unique attraction for electronics manufacturers. Although it's part of the U.S. and boasts productive workers and skilled managers and technicians, it also provides many of the advantages of offshore sites like substantial tax reductions, lower direct labor costs and an effective development agency.

As a result, U.S. firms have established 162 electronics operations in Puerto Rico with over 30 added in the last 2½ years. The latest to announce location there is Hewlett-Packard, which will start producing computer peripherals in a plant in Aguadilla, near a huge facility where Digital Equipment Corp. manufactures minicomputers. HP will begin production in an 86,000-square foot leased facility but has an option to buy a 63-acre tract.

While Puerto Rico once lured industry primarily through tax incentives and the recognized manual dexterity of island workers, today financial programs, the increased sophistication of its work force and a general shortage of skilled labor on the mainland are encouraging many firms already on the island to upgrade their facilities and new entries to build higher value products.

Typical of the older firms in Puerto Rico are General Electric and Westinghouse, with 22 plants each. Most of their production and that of other long-established plants is of relatively small but precision piece parts such as TV picture tubes, guns and transducers.

Many companies also stuff and test circuit board modules. In newer plants there's definitely a trend to building complete equipment: Governor Carlos Romero Barcelo claims that Puerto Rico produces more minicomputers and peripherals than does any other area of the U.S. Digital Equipment makes minicomputers; Qume, daisy wheel printers. Microdata produces CRT terminals, printers and disk drives and will shortly add full computer systems, while Qantel now makes CRT terminals and will soon produce printers and complete stand-alone small business systems.

These companies are discovering that low cost labor and tax advantages are only part of the picture. Many fast-growing electronics firms hard-pressed to find workers and technical help find it readily available in Puerto Rico.

Storage Technology's Aldea: *Producing 10,000 boards per month with 189 rather than 300 employees.*

Key role

Head of Puerto Rico's Economic Development Administration (EDA) is Jose R. Madera, who is working to upgrade the island's industrial base as well as reduce its 16 percent unemployment rate. "Electronics has played a key role in the past three years, and that role is still increasing," he says.

Currently about 17 percent of the island's work force is employed in electronics, although another high technology, pharmaceuticals, still represents a larger total investment.

Key in the upgrading of jobs is a revised tax structure that replaces full tax exemption with a reduced exemption that encourages higher capital investment and a longer range commitment. "We don't say 'come to Puerto Rico and don't pay taxes'. It doesn't make sense to attract companies if we can't provide the infrastructure they need to operate effectively because of inadequate income," says Madera.

The revised rules, which apply to new companies and by agreement to established ones, still provide substantial Federal and Commonwealth tax relief.

Other attractions of Puerto Rico include an average wage that's about 60 percent of the mainland's and the government's policy of helping rather than fighting business: "If there's a conflict between the development agency and a regulatory agency, the governor will step in and make a decision," Madera explains.

The EDA is also trying to attract a few key support operations needed on the island—metal fabrication and printed circuit board manufacturing facilities—in addition to helping tailor educational facilities to the needs of electronics companies at assembly, technician and engineering levels.

Automated facilities

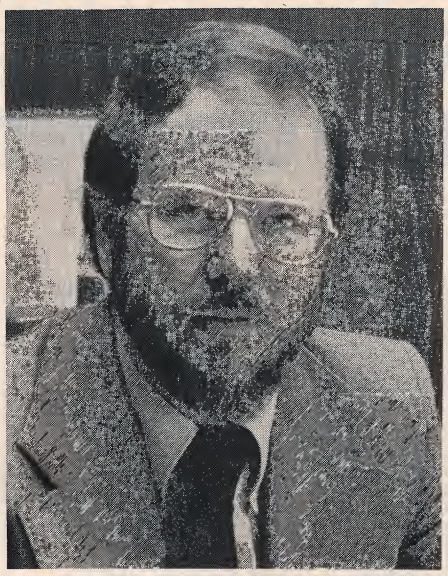
Many firms with plants in Puerto Rico are investing heavily in modern automated equipment for high productivity. One of the most modern of the newer arrivals is Storage Technology Corp.'s 56,000-square foot facility at Ponce on the south shore of the 35 by 105-mile island. STC's first employee there was industrial relations director Jose Juan Aldea, who was recruited in November 1978 from Digital Equipment Corp. He quickly hired a new boss, general manager Eufemio Toucet, also from Digital, plus technicians who went to headquarters in Colorado for a few weeks' training.

Last February Aldea hired 20 people from the streets, trained them for two weeks and was shipping completed tested circuit boards by early March.

The group now produces 10,000 boards a month using 189 employees. Aldea says the original plan called for 300 employees for that level.

In July the plant started producing complete disk drive controllers, the STC Model 8000-2. Initially a staff of inspectors and assemblers from Colorado helped out, but now all have left; the only mainland employee is the materials manager, who is currently training his replacement. Few plants in Puerto Rico have many non-native employees, even general managers.

STC's plant, like many facilities used by electronics firms on the island, is



When—and where—will the aftershock hit?

No one can predict what the next electronic hula hoop will be, but it's a safe guess that like almost all new electronic equipment, it will depend on a microprocessor. That's great news for the semiconductor makers and their suppliers, but it's not likely to be so fortunate for semiconductor users: They face formidable and costly challenges in development, manufacturing and field service before an exciting new product can truly be called successful, and there's a lot of evidence that those challenges aren't being considered fully.

Many firms are already addressing the problem of development, and their solutions seem adequate or on the right track. But less attention has been paid to manufacturing and service problems. That's not surprising: Design and development have always received first crack at talent and attention at most electronics companies. This situation is likely to change in the future though, as it must. A few months back in a little-noticed talk on the aftershocks of the microprocessor explosion, Jerry Casilli, president of Millenium Systems, underscored the problem. He claims that inadequate attention to manufacturing and service could slow the penetration of microprocessors—i.e., electronics—into many new market segments. Casilli, who has an understandable bias since his firm serves the microprocessor market, nevertheless rightly notes that today's automatic test equipment only partly addresses the complex problem of testing microprocessor products, a sentiment most users would echo. He feels, however, that the biggest shock is yet to come in field service, where shortened development cycles will move many new products into the field that must be serviced for at least five to seven years.

These problems will create new opportunities for some firms such as Casilli's; most companies, however, will discover only the problems. And they won't go away until more electronics firms consider them seriously.

Paul Franson

Paul Franson
Editor

Guide to U.S. Plant Sites *(continued)*

Reed College. **Transportation:** port; rail; truck lines. **Contact:** Dean Rainwater, Port of Woodland (206) 225-8400.

City: Kalama

Major attractions: reliable work force; available land. **Tax incentives:** tax deferral on manufacturing facilities; property tax exemptions; no personal or corporate income taxes. **Educational facilities:** Lower Columbia College, Clark College, Lewis and Clark College, universities in Oregon. **Transportation:** local airport, Portland International Airport; port; railroads; truck service; Interstate 5. **Contact:** John Fratt, Port of Kalama (206) 673-2325.

City: Kelso

Major attractions: quality of life; planned industrial park; easy access to transportation. **Tax incentives:** no state, corporate or personal income taxes. **Educational facilities:** Lower Columbia College, college in Vancouver and four colleges in Portland. **Transportation:** Kelso Airport; Port of Longview; major truck lines and railroads. **Contact:** Ernie Parrott, Industrial Park Board (206) 423-7177.

City: Longview

Major attractions: recreational amenities; low cost land in industrial park; available work force; favorable utility rates. **Financial inducements:** industrial park land can be purchased through city without paying commission or excise tax. **Educational facilities:** Lower Columbia College; good public school system; colleges in Vancouver and Oregon. **Transportation:** Kelso Airport, Portland International Airport; truck lines; railroads; Port of Longview. **Contact:** Robert McNannay, Port of Longview (206) 425-3305.

Oregon

State contact: Daniel L. Goldy, Department of Economic Development (503) 229-5535.

California

State contact: Deni Greene, Office of Permit Assistance and Planning and Research (916) 445-0613.

County: Kings

Major attractions: Sierra Nevada Mountains, Pacific Ocean beaches; warm climate; build to specifications. **Financial inducements:** lease programs available. **Educational facilities:** two junior colleges, one four-year university. **Transportation:** Visalia Airport, Fresno Air Terminal; rail services. **Contact:** Donald C. Barnett, Kings County Economic Development Commission, Hanford, Calif.

City: Santa Rosa

Major attractions: quality of life; proximity to San Francisco. **Educational facilities:** Sonoma State University, Santa Rosa Junior College. **Transportation:** Sonoma County Airport, six private airports; Northwestern Pacific Railroad; barge traffic to Petaluma. **Contact:** Michael D. Richie, Economic Development Board (707) 527-2406.

City: Sacramento

Major attractions: 600-acre industrial park with available sites. **Educational facilities:** University of California at Davis, California State. **Transportation:** rail; deep water channel; Interstates 80 and 5. **Contact:** Barney Bartlett, Port Sacramento Industrial Park, West Sacramento, Calif.

City: Riverside

Major attractions: large, available labor pool; reasonably priced industrial land; good schools; sensibly priced housing. **Financial inducements:** city will help pay off-site costs. **Educational facilities:** University of California, Riverside City College, California Baptist College, Loma Linda University. **Transportation:** Riverside Municipal Airport, Ontario International Airport; Union Pacific Railroad. **Contact:** Charles Dole, Riverside Chamber of Commerce (714) 683-7100.

Hawaii

State contact: Hideto Kono, Department of Planning and Economic Development (808) 548-6914.

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To receive more information on the industrial plant sites advertised in this issue, circle the corresponding number on the inquiry card that appears on page 115.

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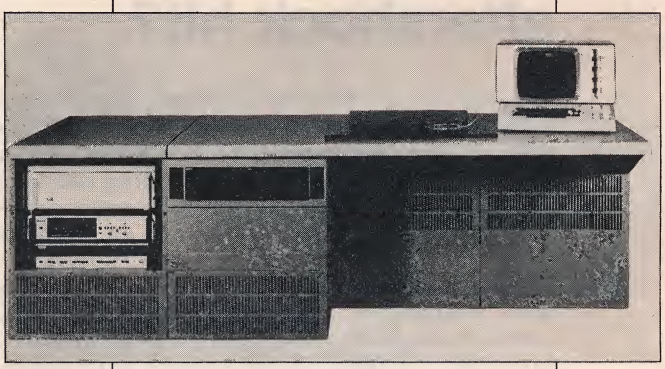

It also offers user-oriented software, a highly convenient fixturing system and superior fault-isolation techniques. All the things necessary for matching the performance of today's digital, analog and hybrid printed circuit board assemblies.

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You don't have to fight to interface additional instrumentation to the Series 70. It has two IEEE 488 buses, so it accommodates more instrumentation than other test systems. And it's not restricted by instrument type or model. So you can use your favorite multimeter, spectrum analyzer or power source.

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more than 60 high schools; Maricopa County Junior College system; Arizona State University. **Transportation:** Sky Harbor International Airport; railroads; motor freight. **Recent firms:** Intel, Continental Circuits. **Contact:** Larry Evans, Salt River Project (602) 273-5259.

City: Tucson

Major attractions: good climate; high quality of life; growing work force; low absenteeism; free trade port; U.S./Mexico twin plant options. **Tax incentives:** no inventory or corporate franchise tax; federal income tax deductable on state returns. **Financial inducements:** revenue bonds. **Educational facilities:** University of Arizona, Pima Community College. **Transportation:** Tucson International Airport; Southern Pacific Railroad; Interstate 10. **Recent firms:** IBM, National Semiconductor, Veeco Industries, General Instrument. **Contact:** Bill Stephenson, Tucson Economic Development Corp., Tucson, Ariz.

New Mexico

State

Major attractions: existing industrial parks with available sites; established research industry; pro-business environment; young, competitive work force; dry climate. **Tax incentives:** investment and compensating tax credits; a freeport law; no inventory taxes; private, corporate and property taxes are below the national average. **Financial inducements:** In-Plant Training grants; revenue bonds. **Educational facilities:** six state universities, four private liberal arts universities, two junior colleges, several vocational/technical schools; University of New Mexico and New Mexico State offer high-technology electronics programs; other schools can tailor programs to industry needs. **Transportation:** Albuquerque International Airport, two regional airports; the Columbus ground port, El Paso air and ground ports; three interstate highways; three major railroads. **Recent firms:** Honeywell, Pertec Computer Corp. **Contact:** Al Dietz, Economic Development Division (505) 827-5571.

County: Bernalillo

Major attractions: abundance of skilled and unskilled labor; good climate; affordable land and housing; proximity to Texas and California; ample energy. **Tax incentives:** no inventory tax; freeport status. **Financial inducements:** industrial revenue bonds; Investment Credit Act; state helps finance in-plant training. **Educational facilities:** Technical Vocational Institute; University of New Mexico, University of Albuquerque. **Transportation:** Albuquerque International Airport; Santa Fe Railroad; interstate highways. **Recent firms:** Pertec Computer Corp., Honeywell. **Contact:** Jim Garvin, Albuquerque Industrial Development Service (505) 842-0400.

City: Farmington

Major attractions: ideal climate; prosperous city government; modern convention center. **Tax incentives:** favorable tax rate. **Financial inducements:** revenue bonds. **Educational facilities:** San Juan Branch of New Mexico State University. **Transportation:** Frontier and Zia Airlines. **Contact:** Farmington Chamber of Commerce (505) 325-0279.

City: Las Cruces

Major attractions: White Sand Missile Range, NASA; industrial park with below market prices. **Tax incentives:** special tax abatements. **Financial inducements:** industrial revenue bonds. **Educational facilities:** Labor Training Program; New Mexico State University. **Transportation:** international airport; two interstate highways; Southern Pacific Railroad. **Contact:** Harlan Westenberg, Greater Las Cruces Industrial Development Board (505) 542-1745.

City: Clovis

Major attractions: abundance of trainable workers; low humidity, light snowfall; low building costs and inexpensive developed industrial sites. **Tax incentives:** freeport provisions. **Financial inducements:** revenue bonds; on-the-job training grants up to $35,000. **Educational facilities:** Clovis High Plains Area Vocational/Technical School. **Transportation:** municipal airport; three major highways; Santa Fe Railroad. **Contact:** J.R. Spencer, Clovis Industrial Commission (505) 763-3435.

PACIFIC STATES

Washington

State contact: Kazuo Watanabe, Department of Commerce and Economic Development (206) 753-7426.

Region: Puget Sound

Major attractions: available labor; affordable housing; favorable business climate. **Tax incentives:** no state corporate net income tax; job development tax credit; deferral credits on new construction and plant expansions. **Educational facilities:** community colleges, universities and four-year colleges, including the University of Washington and Seattle University; on-the-job training. **Transportation:** Sea-Tac International Airport, satellite airports; railroads; four ports. **Recent firms:** HP, National Semiconductor. **Contact:** David A. Bell, Economic Development Council of Puget Sound (206) 622-2730.

County: Yakima

Major attractions: large labor pool; industrial site; planned industrial park. **Tax incentives:** no state income tax. **Educational facilities:** Technical School, Yakima Valley College, Perry Trade School (vocational/technical) Yakima Skill Center. **Transportation:** municipal airport; railroads. **Contact:** Gary W. Webster, Greater Yakima Chamber of Commerce (509) 248-2021.

County: Lewis

Major attractions: available industrial sites; low wage rates; ample labor. **Tax incentives:** low tax base. **Educational facilities:** high schools and two-year community college. **Transportation:** Interstate 5; local airport; railroad. **Contact:** Willard R. Warren (206) 748-8694.

County: Eastern Clark

Major attractions: excellent quality of life. **Tax incentives:** possible deferred sales tax. **Educational facilities:** community college; a four-year institution. **Recent firms:** HP, Tektronix, National Semiconductor. **Contact:** Jack Israel, Port of Camas-Washougal (206) 835-2196.

County: Clark

Major attractions: modern housing; good school system; close to mountains and beaches; fully serviced industrial sites available; large labor pool. **Educational facilities:** Clark College, Lewis & Clark College, Portland State University, University of Portland, Reed College, Oregon Graduate Center. **Transportation:** Portland International Airport; Port of Vancouver; Burlington-Northern, Union Pacific Railroads. **Recent firms:** HP, Tektronix, National Semiconductor. **Contact:** K.S. Hodge, Clark County Industrial Bureau, Vancouver, Wash.

County: Douglas

Major attractions: new site development; reasonable utility rates. **Financial inducements:** tailor-made financial packages. **Educational facilities:** Wenatchee Valley Community College. **Transportation:** Pangborn Airfield. **Contact:** Ed Daling, Port of Douglas County (509) 884-4700.

County: Thurston

Major attractions: central location; good livability. **Educational facilities:** Evergreen State College, St. Martin's College, University of Washington. **Transportation:** Olympia Airport; Ocean Port of Olympia; railroads. **Contact:** Gene W. Sibold, Port of Olympia (206) 357-4433.

City: Port of Benton

Major attractions: fast-growing area; two industrial parks. **Tax incentives:** no state corporate or personal income taxes; up to eight years' deferrment on new plant and equipment expenditures. **Financial inducements:** industrial buildings constructed or leased at rental rates. **Educational facilities:** vocational education; Columbia Basin Junior College electronics programs; Joint Center for Graduate Study sponsored by universities in Oregon and Washington. **Transportation:** regional and commuter airports; rail; highway; port. **Recent firms:** Alpha-III Enterprises, Azurdata, HP, Tektronix, National Semiconductor. **Contact:** Douglas Edison, Port of Benton (509) 375-3060.

City: Woodland

Major attractions: available work force; undeveloped land. **Tax incentives:** no state income tax. **Educational facilities:** Lower Columbia College, Clark College, University of Portland, Portland State, Lewis and Clark,

Guide to U.S. Plant Sites *(continued)*

Utah

State contact: Michael Gallivan, Department of Development Services (801) 533-5961.

County: Weber

Major attractions: surplus labor; high quality of life; competitive cost of living. **Tax incentives:** no inventory (ad valorem) tax; no sales tax on manufactured products; reasonable personal and property taxes. **Financial inducements:** revenue bonds; low property costs. **Educational facilities:** Weber State College; University of Utah, Salt Lake City and Utah State graduate extension programs. **Transportation:** Salt Lake International Airport, Ogden Airport; rail services; five interstate motor carriers. **Recent firms:** Intersil, Inc., Bourns, Inc. **Contact:** Calvin L. Jeanselme, Weber County Industrial Development Corp. (801) 627-1333.

Colorado

State contact: Russell B. Caldwell, Division of Commerce and Development (303) 839-2205.

Region: Denver metropolitan

Major attractions: appealing climate; year-round recreational options; highly educated work force; growing electronics industry; site and building referral service. **Tax incentives:** investment and inventory tax credit; machinery sales tax exemption; no state sales tax on food and utilities. **Educational facilities:** over 500 public elementary and secondary schools; 10 higher education institutions. **Transportation:** Stapleton International Airport; seven railroads. **Recent firms:** Unirad Corp., NCR, TI, Inmos Corp., Ampex, Synthes Ltd. **Contact:** Thomas A. Letourneau, Economic Development Department, United Banks of Colorado (303) 861-4700.

County: Pueblo City

Major attractions: Pueblo Reservoir; availability of electronic assembly workers; DOT Test Center; GPO Document Center; quality of life; growth-oriented business climate. **Financial inducements:** revenue bonds. **Educational facilities:** University of Southern Colorado (polytechnical); electrical training programs available at Pueblo Vocational Community College. **Transportation:** municipal airport; four class-one railroads; 53 intra- and interstate motor freight lines. **Contact:** William H. Hall, Pueblo Development Commission (303) 546-1133.

Counties: Adams and Arapahoe

Major attractions: industrial land and buildings available; population influx; metropolitan area amenities. **Financial inducements:** revenue bonds. **Educational facilities:** 30 higher education institutes within 50-mile radius. **Transportation:** Stapleton International Airport; two interstate highways; Union Pacific Railroad. **Contact:** Don Jacobson, ECO Aurora (303) 750-2500.

County: Jefferson

Major attractions: moderate climate; pro-business city and county governments; proximity to Rocky Mountains. **Tax incentives:** moderate tax rates. **Financial inducements:** revenue bonds. **Educational facilities:** Warren Tech Center; University of Colorado, University of Denver. **Transportation:** Jefferson County Airport, Stapleton International Airport; five major railway systems; highways. **Contact:** Suzanne Phipps, Industries for Jefferson County (303) 278-3626.

City: Boulder

Major attractions: Eastpark Business Park—30 minutes from Denver, fully landscaped, with many related companies. **Educational facilities:** University of Colorado. **Transportation:** Stapleton International Airport; rail. **Recent firms:** NBI, Storage Technology. **Contact:** Bill Arnold, Eastpark Associates (303) 447-2655.

Arizona

State contact: Brent W. Brown, Arizona Office of Economic Planning and Development (602) 271-5371.

Region: metropolitan Phoenix

Major attractions: beautiful climate; informal and active lifestyle; well-educated population. **Tax incentives:** no inventory or corporate franchise taxes; full deduction of federal and state income tax prior to calculating state income tax; no tax on income paid to parent companies by subsidiaries if parents own 50 percent or more of subsidiaries and are headquartered in Arizona. **Educational facilities:** over 300 elementary schools and

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Electronic Business/U.S.

R&D funding to reach new high in 1980

Expenditures in calendar 1980 for R&D in the U.S. are expected to reach $61.8 billion, according to a forecast from Battelle's Columbus, Ohio, Laboratories. This figure represents an increase of $10.2 billion (19.7 percent) over the $51.6 billion that the National Science Foundation estimates was to be actually spent for R&D in 1979.

The largest source of funding will be the federal government (49.5 percent), followed by private industry (47.0 percent), academic institutions (2.1 percent) and nonprofit organizations (1.4 percent). Industry, however, will account for most (71.9 percent) of the R&D performed, with the remainder of expenditures made by the federal (13.0 percent), academic (12.1 percent) and nonprofit (3.0 percent) sectors. ■

HP introduces personal computer; assesses market

Hewlett-Packard has entered the low-cost personal computer market with a $3250 model that includes keyboard, printer, tape cartridge and graphics display in one typewriter-sized unit. The new HP-85 is intended primarily for professional users, whom HP sees as accounting for 23 percent of the approximately 200,000 personal computers in place at year end 1979.

Although the HP-85 does not compete against offerings from the likes of Radio Shack, Commodore, Heath and Apple for the very low cost (base priced under $1000) home market, which comprises most (52 percent) of the personal computers in use, it does compete against them for non-home applications. In addition to professional uses, these include very small business (13 percent of installed personal computers), educational (7 percent) and industrial (5 percent) applications. By 1982, predicts HP, non-home applications will account for the majority (69 percent) of personal computer units, and fewer systems designed originally for the home will be considered acceptable for non-home applications.

The HP-85 is being marketed primarily through third-party computer stores and office equipment dealers. ■

IBM's network strategy

According to a recent Yankee Group survey of large IBM electronic data processing (EDP) users, only 40-45 percent of original 4300 orders and less than 30 percent of 8100 orders are to be ultimately accepted. However, surveyed users are moving ahead with multiapplication, multihost networking plans.

The Cambridge, Mass., consulting firm believes the IBM strategy—to ride the technology curve and to leverage its dominant EDP industry position—rests on three tactics:

- To extend the efficiencies of its mainframe computer business in order to preserve and perpetuate the hierarchical host-oriented computer network;
- To counterpunch the distributed data processing market with a variety of products that focus on coherent networks and specifically on the "satellite" processor; and
- To prime the pump for a new generation of computing applications through data base software, unbundling and pricing in order to enhance programmer productivity so that new software development can proceed without program maintenance bottlenecks. ■

Computer industry must adapt to succeed, warn market analysts

A five-year forecast of the computer industry prepared by Arthur D. Little, Inc., Cambridge, Mass., concludes that vendors can emerge from relatively flat growth in 1979 and improve revenues only if they take steps to adapt to an increasingly competitive environment. "Otherwise, shifts in product demand, protectionism overseas and outmoded pricing policies and cost structures will persist as long-term problems," the forecast says.

The report pegs 1979 combined data processing revenues at $29.4 billion for the seven largest U.S.-based computer vendors and plug-compatible mainframe vendors, which constitute more than 80 percent of the domestic industry. The estimate includes all revenue sources related to computer-based products and services except for special military systems, and represents a growth of only 2.1 percent over their $28.8 billion revenues in 1978. The 1979 value (at purchase list) of general purpose computer shipments (including machine-room peripherals) is estimated at $19.5 billion, up 6.5 percent from $18.4 billion in 1978.

The ADL researchers explain that the industry's performance in 1979 was pulled down by IBM. They estimate that IBM is experiencing a 4.5 percent decline in data processing revenues and only a 3 percent growth in shipments because of its large computer customers who prefer to lease rather than make major investments in equipment they might soon wish to replace with newer models. While that trend is causing a temporary revenue problem, IBM will soon experience a surge in shipments of its new smaller systems.

Despite this surge, the ADL researchers believe that U.S. vendors can achieve a constant dollar increase averaging only between 7 and 9 percent through 1984. They predict that the group's data processing revenues will rise faster, possibly averaging 10 to 15 percent a year in constant dollars. However, aggressive pursuit of communications equipment, office systems and other fast-growing product areas is seen as essential for such growth.

The researchers also believe that the industry must continue the trend to separate pricing of software and services, and that vendors need to readjust their internal cost structures in a period of declining component costs, increasing personnel costs and economic uncertainty. ■

Here come the robots

After more than 15 years of slow and painful growth, the market for industrial robots is about to explode, according to a report by International Resource Development, Inc., Norwalk, Conn., a marketing consulting firm. The report estimates that while the robot market currently amounts to only $40 million annually, it is now a sellers market, and the major manufacturers have order backlogs of a year or more. The result is increasing interest of computer makers, such as Texas Instruments and Digital Equipment Corp., in an arena now controlled by specialty suppliers like Unimation or machine tool manufacturers like Cincinnati Milacron.

The IRD report found that organized labor in the U.S. has so far been "relatively accommodating" about the deployment of robots because robots still account for only a small volume of blue-collar operations, typically in unpleasant environments like foundries where they perform the "dirtiest and hottest" tasks. However, the new families of robots will offer significantly expanded capabilities, e.g., vision and the ability to learn from their own experience, which will permit their use in the high-precision assembly of equipment with small and delicate parts, including electronic devices and household appliances.

"Someday," concludes the report, "robots will be used to assemble other robots, thus in a sense endowing them with reproductive capabilities." ■

Guide to U.S. Plant Sites *(continued)*

Arkansas Department of Economic Development (501) 371-1121.

Texas

State contact: James H. Harwell, Texas Industrial Commission (512) 475-4331.

City: McAllen

Major attractions: Texas/Mexico Border Industrialization Program (twin plant concept); McAllen Foreign Trade Zone. **Tax incentives:** no corporate or personal income taxes; second lowest city tax rate in Texas. **Educational facilities:** Pan American University. **Transportation:** Texas International Airline; seven truck lines; railroads. **Recent firms:** Zenith Radio Corp., Tenna Corp., General Electric Co. **Contact:** Frank Birkhead, Jr., McAllen Industrial Board (512) 682-2875.

City: Harlingen

Major attractions: sub-tropical climate; high quality of life. **Financial inducements:** revenue bonds. **Educational facilities:** Texas State Technical Institute; Pan American University. **Transportation:** Harlingen International Airport; Port of Harlingen. **Recent firms:** American Jet Industries, General Electric. **Contact:** David E. Allex, Harlingen Industrial Foundation, Inc. (512) 423-5447.

City: Corpus Christi

Major attractions: good living environment with plentiful cultural and recreational options; low operating costs; productive workers; right-to-work laws. **Tax incentives:** no state corporate or personal income taxes; low unemployment insurance tax rate. **Financial inducements:** industrial revenue bonds. **Educational facilities:** Del Mar College, Corpus Christi State University, Texas A & M University Research and Extension Center, Texas A & I University. **Transportation:** railroads; airport; Port of Corpus Christi. **Contact:** Brodie Allen, Corpus Christi Industrial Commission (512) 883-5571.

City: Irving

Major attractions: all supporting services; over 6000-acre business community; easy accessibility. **Tax incentives:** low tax rate. **Educational facilities:** University of Dallas, Northlake College; Cistercian Preparatory School. **Transportation:** Dallas/Ft. Worth International Airport; freight service; rail. **Recent firms:** Boeing Aerospace. **Contact:** Bob Bradshaw, Southland Real Estate Resources (214) 255-8506.

City: Amarillo

Major attractions: fast-growing economy; ample energy; high quality of life; existing industrial parks. **Financial inducements:** industrial revenue bond financing. **Educational facilities:** one vocational/technical institute; two state colleges. **Transportation:** three railroads; five commercial airlines; 31 freight carriers; highways. **Recent firms:** Crouse-Hinds Corp. **Contact:** G. Pat Walsh, Amarillo Board of City Development (806) 374-2861.

Louisiana

State

Major attractions: hard-working labor force; outdoor lifestyle; ample energy; foreign trade zone; pro-business climate; low wage rates and cost of living. **Tax incentives:** state, county and local property tax exemptions on buildings and equipment for up to 10 years; $100 per job tax credit. **Financial inducements:** revenue, general obligation and port, harbor and terminal district bonds. **Transportation:** ports; airport. **Contact:** Mike Bourgeois, Louisiana Office of Commerce & Industry (504) 342-5381.

MOUNTAIN STATES

Montana

State contact: Jim Flynn, Governor's Office of Commerce (406) 449-3923.

Idaho

State

Major attractions: relatively low cost energy supply; productive labor force; air connections to major markets; high quality of life; growing economy; large population influx. **Tax incentives:** lowest tax burden of all western states. **Transportation:** airport, deep water port facilities; four major rail lines. **Recent firms:** Zilog Corp. **Contact:** Steve Wilson, Division of Tourism and Industrial Development (208) 334-2470.

Wyoming

State contact: John Niland, Department of Economic Planning and Development (307) 777-7284.

Nevada

State contact: R.E. Goodman, Department of Economic Development (702) 885-4322.

Region: Southern Nevada

Major attractions: Nellis Air Force Base; home of Consumer Electronics Show; atmosphere conducive to entertaining clients/corporate officials. **Tax incentives:** no corporate or personal income taxes; personal property tax 1.27 percent of full value. **Financial inducements:** revenue bonds. **Educational facilities:** University of Nevada Las Vegas, Clark County Community College; Southern Nevada Vocational Technical High School. **Transportation:** Union Pacific Railroad; McCarran International Airport; North Las Vegas Air Terminal. **Recent firms:** GTE Sylvania, Superior Cable, Semtech. **Contact:** Tim Carlson, Nevada Development Authority (800) 634-6857.

(continued)

FOR MORE INFORMATION

To receive more information on industrial plant location advertisers, see the reply card in this issue on page 115.

Sri Lanka focuses on electronics

In a recent re-ordering of industrial development priorities, Sri Lanka (formerly Ceylon) government planners placed electronics on top of their list for development through foreign investment.

The government shifted emphasis to electronics from its burgeoning garment industry because import barriers threaten to limit Sri Lanka's overseas sales. Besides barriers already raised by some European countries, the U.S. is expected to institute quotas on textile imports from Sri Lanka within two years.

Sri Lanka's new emphasis on electronics comes at a good time: Inflation, shrinking labor pools and other factors are making traditional offshore plant sites in the Far East like Singapore, Taiwan and Korea unattractive for labor-intensive, high-volume assembly operations that characterize many consumer electronics products.

As of last October, 13 plants employing 14,000 workers were in production in the island's free-trade zone. Forty-three other foreign companies are committed to locate there. Others are expected to follow when two additional trade zones already planned are opened.

A mission from the Greater Colombo Economic Commission (GCEC), the government agency responsible for development of the country's export potential, will visit West Coast U.S. cities next month to promote investment. ■

Radio, TV imports down in third quarter

U.S. unit imports of many consumer electronics products, including TVs, radios and most tape players, declined in the third quarter of 1979 compared with the same period of 1978, according to the Electronic Industries Association's Consumer Electronics Group.

Monochrome TV imports of 1,592,145 units in the third quarter of 1979 were down 7.8 percent from the same period a year ago, color TV imports of 323,661 units represented a 58.9 percent decline, and home radio imports of 8,070,325 units were down 30.4 percent.

Significant increases in third quarter consumer electronics imports were scored by phonographs (350,746 units, up 28.8 percent from a year ago) and video tape recorders/players (149,340 units, up 8.8 percent). Imports of video tape players (only) decreased 7.0 percent to 17,287 units, and imports of audio tape recorders/players were off 6.7 percent from the 1978 third quarter level of 4,950,357 units. ■

Japanese semi production firms move into U.S. market

Japan, which until now has relied on U.S. production and testing equipment for semiconductor manufacturing, has begun to export some of its own equipment to the U.S. Tight domestic supply coupled with improving quality of Japanese-made equipment has attracted U.S. buyers.

At the Semicon Japan '79 show last December, Japanese exhibitors reported increasing inquiries from and sales to U.S. buyers. Canon Sales Co. has shipped 40 to 50 of its auto proximity mask aligners to U.S. customers in the past six months. Ulvac Corp., which has sold in the U.S. for four years, is so successful with its vacuum and sputtering equipment that it will construct an assembly plant in Maine this spring.

Other Japanese firms, Tokyo Ohka Kogyo Co., Ando Electric Co. and Takeda Riken Industry Co., are planning to enter the U.S. market. ■

Common Market auto diagnostic sales to hit $692.7 million in 1987

Sales of automotive equipment in 10 Common Market countries are projected to increase 88 percent between 1980 and 1987 to $692.7 million, according to an analysis of the industry by market research firm Frost & Sullivan in New York.

In the 10-country market, Italy will lead in total volume and Spain will record the largest gain, with the United Kingdom and France also showing increases in sales of engine analyzers, ignition and electric test equipment, multifunction equipment and other diagnostic systems.

Imports of auto diagnostic products by all countries will rise almost 45 percent from 1980 to 1987 to $102.9 million, largely because Common Market manufacturers won't be able to meet demand.

Italy's spending for equipment will climb to $159 million in 1987. Although there are a few strong Italian producers, imports are expected to grow between 11 and 14 percent yearly. The West Germans hold a 40 percent share of imports; U.S. firms, 21.3 percent. But the Japanese are bidding strongly for Italian sales.

By 1987 France will be the second largest buyer with sales at an estimated $137 million. French auto diagnostic imports will expand 163 percent to $94.7 million.

The United Kingdom market will grow to $132.5 million by 1987. Great Britain should be a prime market for foreign manufacturers, with imports predicted to rise 139 percent to $94 million. Eventually diagnostic imports should exceed domestic production.

Although West Germany's market will grow 67 percent to $102.9 million in 1987, it will export nearly 65 percent of its production. The strength and sophistication of West German manufacturers will make the market difficult for foreign firms to penetrate.

Rapidly expanding car sales in Spain will generate a growth explosion in the market of 350 percent, from $20 million in 1977 to $90 million in 1987. Spain will also offer the best import opportunities: With little local competition, imports are forecast to grow 460 percent to $83 million in 1987.

Among the five remaining Common Market nations, the Netherlands' buys of auto diagnostic equipment will double to $28.5 million. Sweden's purchases will more than double to $21.7 million, while the Belgium market will gain moderately to reach $14.5 million. Both Denmark and Ireland will be minor factors in the market. ■

United Kingdom component demand surges

The United Kingdom's electronic component market will post short-term gains in excess of 14 percent in 1980 as measured in current British pound values, says Ralph Anavy, vice president of market research firm Gnostic Concepts, Inc. in Menlo Park, Calif. This substantial overall gain will be exceeded by that of specific component types, as the accompanying chart illustrates.

U.K. components growing over 15%

Component type	1980 growth
Switches	15.5%
Connectors	15.6%
Printed circuits	18.8%
Linear ICs	18.9%
Digital ICs	23.0%
Optoelectronics	17.1%
Hybrids	23.6%

The communications industry is the largest end user sector, consuming 29 percent of all components, followed by the consumer equipment sector with a 22 percent share. ■

Air Command; recreational sites. **Tax incentives:** property tax exemption. **Financial inducements:** Omaha Foreign Trade Zone; industrial revenue financing. **Educational facilities:** 20 vocational and business schools; four universities; two technical schools; two medical schools. **Transportation:** one commercial airport, four corporate airports; Port of Omaha; eight major railroads. **Recent firms:** Western Electric, McMartin Industries, Reliance Battery Mfg. Co., Industrial Reels Electric Co. **Contact:** Rod Moseman, Omaha Economic Development Council, Omaha, Neb.

Iowa

State contact: Gary Owens, Iowa Development Commission (515) 281-3500.

Kansas

State

Major attractions: strategic location; foreign trade zones; population influx; well-educated, easily trainable work force; low construction, land and utility costs. **Tax incentives:** Freeport Law; 10 year moratorium on ad valorem taxes. **Financial inducements:** industrial revenue bonds; Job Expansion and Investment Credit Act. **Educational facilities:** six public universities; 17 private and four two-year colleges; 14 vocational/technical schools; one technical institute; industrial training program. **Transportation:** Kansas City International Airport; rail; trucking lines; waterways. **Contact:** Roland A. Loveless, Kansas Department of Economic Development, Topeka, Kan.

Region: Southeast

Major attractions: readily available industrial space; right-to-work law; preemployment training; reasonable wage rates. **Tax incentives:** job expansion and investment tax credits; Freeport Law; real estate tax moratoriums. **Financial inducements:** industrial revenue financing; cash basis state government. **Educational facilities:** one four-year state university; six public junior colleges; three vocational/technical schools; one state technical institute. **Transportation:** 12 general aviation airports, two commercial airports; five rail lines.

County: Geary

Major attractions: easy access to transportation; available industrial sites. **Financial inducements:** tax-free revenue bond financing. **Educational facilities:** Kansas State University, University of Kansas. **Transportation:** Junction City Municipal Airport, Manhattan Airport; rail service; interstate highway. **Contact:** John C. Majerus, Junction City-Geary County Economic Development Commission (913) 762-1976.

County: Dickinson

Major attractions: Bicentennial Center and other recreational facilities; good quality of life. **Financial inducements:** revenue bonds. **Educational facilities:** two four-year colleges, one business college. **Transportation:** three railroads; municipal airport; interstate highways. **Contact:** Roger L. Whitworth, Salina, Kan. (913) 827-9301.

Missouri

State contact: Steven R. Hurst, Division of Commerce and Industrial Development (314) 751-4241.

WEST SOUTH CENTRAL

Oklahoma

State contact: Scott Eubanks, Department of Industrial Development (405) 521-2401.

Arkansas

State

Major attractions: large electronic motor market; plentiful, trainable work force; right-to-work state; low cost land and buildings; foreign trade zone; pro-business legislature; anti-violence act; high quality of life. **Tax incentives:** lowest per capita tax burden in U.S.; no sales tax on new machinery or raw materials; no sales or use tax on pollution control equipment; no property tax on firms financed through revenue bonds. **Financial inducements:** 100 percent financing through revenue bonds. **Educational facilities:** state financed worker-training program; 12 universities and colleges; junior colleges; vocational/technical trade schools. **Transportation:** water; air; truck; rail. **Recent firms:** Teletype Corp., LaBarge Electronics Co. **Contact:** Windell R. Adams,

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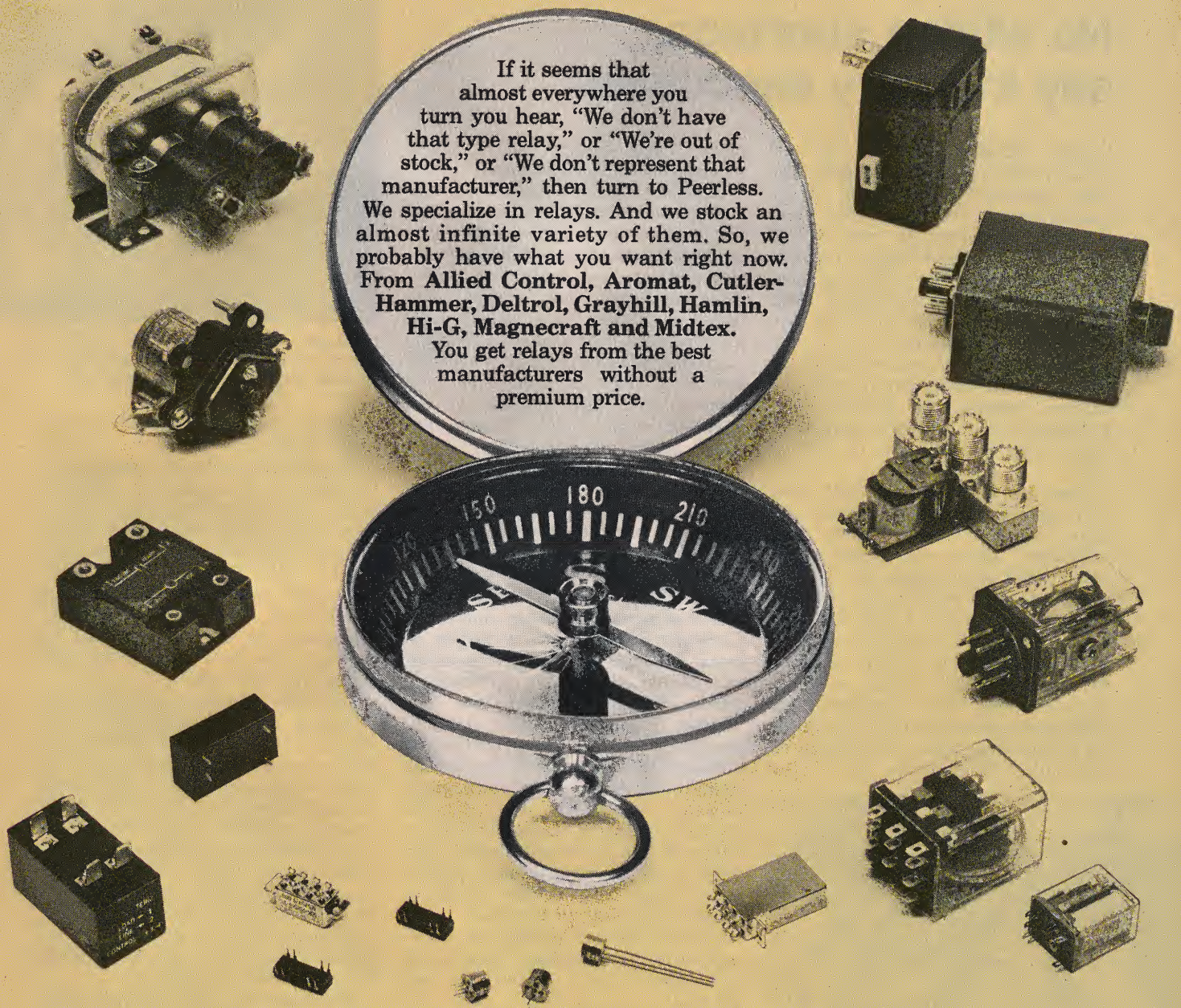

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Guide to U.S. Plant Sites *(continued)*

University, Moorhead State University, Concordea College. **Transportation:** rail; airport; highways. **Recent firms:** Kraus Industries. **Contact:** Bob Enusau, Fargo Coss County Industrial Development Corp. (701) 237-6132.

South Dakota

State contact: Richard M. Garness, Department of Economic and Tourism Development (605) 339-6779.

City: Sioux Falls

Major attractions: fully serviced Sioux Empire Industrial Park; abundant energy; pro-business environment; low cost of living. **Tax incentives:** low per capita tax load; no corporate or personal income taxes. **Financial inducements:** variety of public and private funding sources; industrial revenue bonds. **Educational facilities:** vocational/technical training; three private colleges. **Recent firms:** Litton Microwave. **Contact:** Sioux Falls Development Foundation (605) 339-0103.

Minnesota

State contact: Lee Vann, Department of Economic Development (612) 296-2755.

City: Faribault

Major attractions: small town atmosphere but close to Minneapolis and St. Paul. **Educational facilities:** one vocational/technical school; Carlton College and St. Olaf College. **Transportation:** rail, airport. **Contact:** Faribault Industrial Corp. (507) 334-4381.

Nebraska

State

Major attractions: productive labor force; lowest electrical rates in the Midwest; excellent business climate; pro-business attitude of both labor and government; industrial sites and parks; available buildings. **Tax incentives:** no personal property tax on inventory. **Financial inducements:** low unemployment insurance cost and workmen's compensation insurance; industrial revenue bonds. **Educational facilities:** 19 universities and four-year colleges; six community college areas near 13 companies. **Transportation:** 13 commercial airports; nine communities with port facilities; five railroads. **Contact:** Chuck Elliot, Nebraska Department of Economic Development (402) 471-3111.

County: Lancaster

Major attractions: available skilled labor; excellent quality of life. **Tax incentives:** no inventory or equipment tax. **Financial inducements:** low unemployment compensation rates; industrial revenue bonds. **Educational facilities:** University of Nebraska, Nebraska Wesleyan University, Union College, Southeast Community College (technical training). **Transportation:** Lincoln Municipal Airport; Interstate 80; five railroads; over 40 truck lines. **Contact:** David E. Wolvin, Lincoln Chamber of Commerce (402) 432-7511.

City: Omaha

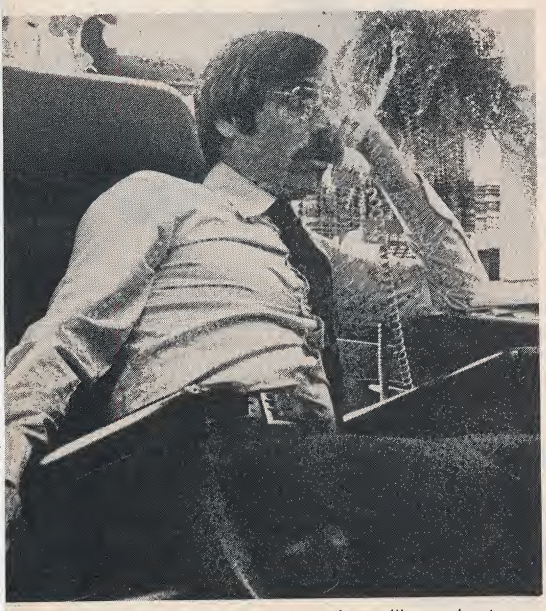
Major attractions: Offutt Air Base Strategic

No silicon shortage, say industry executives

Despite persistent rumors of an industry-wide shortage of silicon, the basic material in integrated circuit manufacture, executives from raw materials producers as well as IC suppliers discount such reports. They say more subtle factors are at play that have been interpreted as a shortage by some IC users, most notably electronic toys and games manufacturers.

Feeding the rumors are such culprits as tight materials supply due to heavy IC demand, overcapacity problems and anticipation of an explosive increase in silicon usage for solar cells by 1981 or '82.

Siltec, Inc. in Menlo Park, Calif., buys polycrystalline silicon from suppliers like Dow Corning, Wacker Siltronics and Monsanto, grows the single-crystal silicon from which wafers are cut and supplies finished wafers to the semiconductor manufacturers. President Robert Lorenzini says he's getting all the poly he needs but admits that his firm's capacity to convert it into wafers is being expanded to meet demand. He emphasizes that while silicon is being put on an allocation basis and leadtimes on new orders are typically four to five months, what emerges isn't a silicon shortage but rather tight supply.



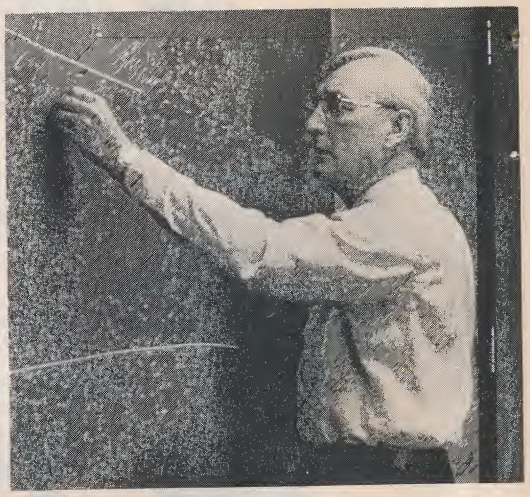
LSI's Colino: *"If there is a silicon shortage, I haven't seen it."*

Intel Corp. in Santa Clara, which buys polished wafers for IC manufacture, has had to wait up to four months for a supply. But according to Will Kauffman, vice president and director of components production, four months don't represent a shortage because such leadtimes have been accounted for in the long range planning of the IC production process. "I think the wafer supply has been a little tight because of the increased demand for ICs," he says, "but there's no shortage now."

Larger IC manufacturers like Motorola and Texas Instruments, which produce wafers from the ground up, also report no difficulty getting what they need when they need it. Indeed, TI currently has excess capacity and is now selling wafers to outside customers when there's an inventory buildup. And at LSI Computer Systems, Inc., a custom IC maker in Melville, N.Y., vice president of marketing Ron Colino says if there is a silicon shortage, it's not apparent.

What is apparent is that many IC companies can't build parts, particularly advanced technology ones, fast enough to meet user demand. Andy Sass, group director of business and technical research at General Instrument Corp. in Hicksville, N.Y., believes some firms might be using a purported lack of silicon to cover up their inability to deliver devices. "It's easy for a company to say 'I'd love to ship your product, but I can't buy silicon'," he explains. "That sounds so fundamental that the customer can't get mad."

LSI's Colino takes the overcapacity problem a step further into the testing of processed wafers and finished devices. "The IC companies are buying capital equipment for testing at record rates," he says. "Just because you can make 10 times as many devices to meet increased demand doesn't mean you can test 10 times as many." And Intel's Kauffman, who admits to a capacity crunch at his firm, attributes it to the wafer fab area. "The high demand is principally for more advanced components like 16k dynamic RAMs and EPROMs, and the problem will likely continue at least for the short term," he predicts.



Hemlock's Bill May: *"What some industry people worry about most is an explosive increase in silicon demand for solar cells."*

But according to Bill May, president of Hemlock Semiconductor in Midland, Mich., "The main worry some industry people have is an explosion in silicon usage for solar cells in the 1981-82 time frame." Siltec's Lorenzini agrees: "I think some people are getting panicky and starting to stockpile silicon in anticipation of solar cell demand. A shortage could well occur if the solar energy issue takes off."

Dan Rose, president of research and consulting firm Rose Associates in Los Altos, Calif., says the potential for a polycrystalline silicon shortage exists based on present capacity and future demand. Rose notes that in 1978, the IC industry consumed about $360 million worth of wafers representing roughly 513 million square inches. While the 1979 figures are unavailable, he thinks they'll be about 30 percent higher than 1978's. And by 1983, Rose says wafer usage will exceed $731 million, representing about 895 million square inches.

By comparison, silicon for photovoltaic cell usage in 1978 amounted to only eight million square inches. But by 1986, Rose predicts solar cell production will consume a phenomenal 6.3 billion square inches, or roughly 10 times the requirement for IC device production.

As a result, "the materials suppliers are facing some major decisions," Rose says. "It takes about $100 million to set up a poly plant. If the future were clear I think they'd make the investment, but now there are too many uncertainties."

A possible outcome of the Depart-

Continued on page 30

Kentucky

State contact: Tom Fields, Industrial Development Division, Kentucky Department of Commerce (502) 564-4270.

Alabama

State

Major attractions: over 400 site locations on from five to 500 acres; right-to-work state. **Tax incentives:** no local and state sales taxes on construction materials; ad valorem tax exemptions for land, buildings and equipment. **Financial inducements:** comparatively low interest rates; 100 percent financing through industrial development bonds. **Educational facilities:** industrial development training program; 13 state-supported and 15 independent colleges and universities; 19 state-supported and six independent junior/community colleges; 28 state technical institutions. **Transportation:** waterways; Port of Mobile; Alabama State Docks; carrier service; six railways; 121 airports. **Recent firms:** Lima Electric Co. **Contact:** Fred F. Denton, Jr., Alabama Development Office, Montgomery, Ala.

County: Mobile

Major attractions: recreational facilities; good quality of life; economic vitality; growing labor force; right-to-work state. **Financial inducements:** industrial revenue bonds. **Educational facilities:** University of South Alabama, Springhill College, Mobile College. **Transportation:** municipal airport; Port of Mobile; five railroads. **Contact:** Ted L. Hackney, Mobile Area Chamber of Commerce, Mobile, Ala.

Tennessee

State

Major attractions: strategic market location. **Educational facilities:** industrial training, vocational/technical schools; five engineering schools, including University of Tennessee and Vanderbilt University. **Transportation:** 73 airports; motor freight; port cities. **Recent firms:** Tabuchi Electronics Co., Square D. Co. **Contact:** Wendy Bush, Department of Economic and Community Development (615) 741-1888.

WEST NORTH CENTRAL

North Dakota

State contact: Bruce L. Bartch, Business and Industrial Development Department (701) 224-2810.

City: Fargo

Major attractions: modern industrial park; productive work force; recreational facilities; healthy business climate. **Tax incentives:** five year property tax exemption plus up to five year corporate income tax exemption. **Financial inducements:** 100 percent financing for land, buildings and major equipment. **Educational facilities:** North Dakota State

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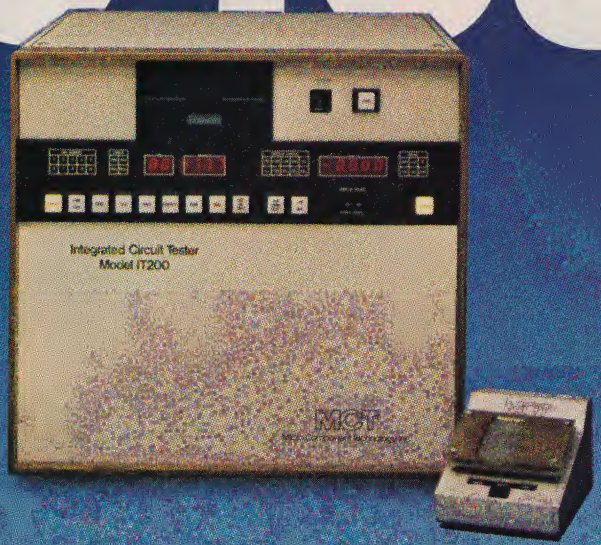

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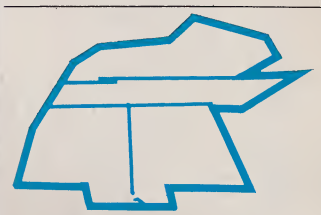
Guide to U.S. Plant Sites *(continued)*

Lake Erie; seven major airports, 86 state/county airports; over 2500 common carrier truck lines. **Recent firms:** Rockwell International. **Contact:** James A. Duerk, Department of Economic and Community Development (614) 466-2480.

Region: Ohio Southland

Major attractions: industrial parks; new $5 billion federal nuclear enrichment plant; skilled labor force and manpower training. **Financial inducements:** loan fund; financing packages. **Educational facilities:** Shawnee State Community College; Scioto Joint Vocational School; distributive education. **Transportation:** Scioto Regional Airport; railroads; five Ohio River ports. **Contact:** Robert J. Stapleton, Scioto Economic Development Corp. (614) 354-7779.



EAST SOUTH CENTRAL

Mississippi

State contact: Mike Amis, Mississippi Agricultural and Industrial Board (601) 354-6710.

Region: port cities, Jackson

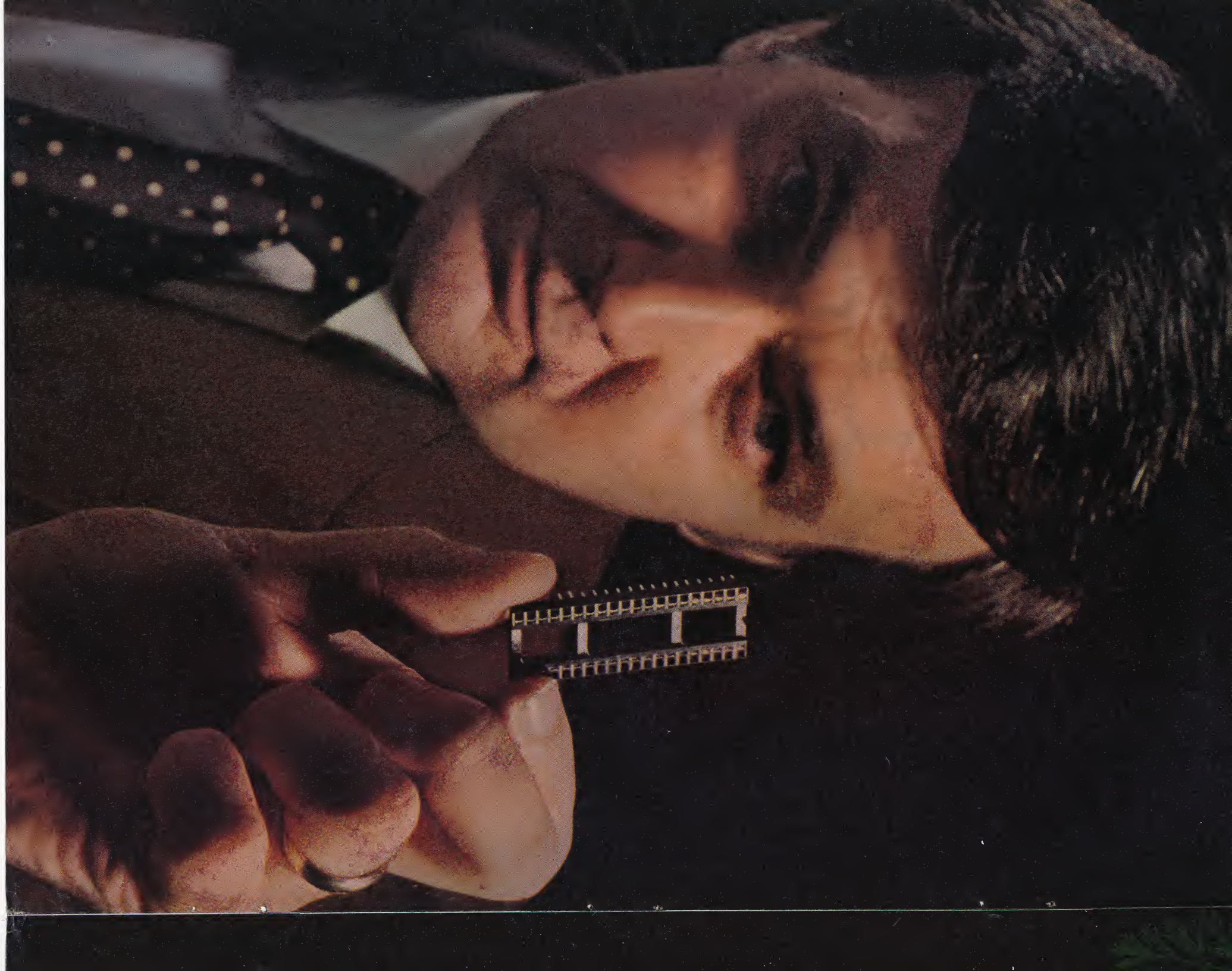
Major attractions: relatively mild climate; surplus labor; low wages; statewide job bank. **Tax incentives:** local ad valorem tax exemptions; accelerated depreciation; finished goods tax exemptions for products sold outside the state. **Financial inducements:** full faith and credit bonds; industrial revenue bonds. **Educational facilities:** junior colleges; state universities; private and denominational colleges. **Transportation:** deep water ports; 75 public airports; 14 national highways. **Contact:** Henry W. Berry, Mississippi Power & Light Co. (601) 969-2307.

County: DeSoto

Major attractions: Holiday Industrial Park. **Tax incentives:** 99- and 10-year property tax exemptions. **Financial inducements:** revenue bonds. **Educational facilities:** free employee training tailored to company needs. **Transportation:** Memphis International Airport, Memphis-Olive Branch Airport. **Contact:** Holiday Industrial Park (601) 895-2976.

City: Long Beach

Major attractions: industrial sites, healthy business climate available; 20 miles from Air Force electronics headquarters. **Tax incentives:** 99-year ad valorem tax exemptions. **Financial inducements:** industrial revenue bonds; free port. **Educational facilities:** two local colleges, three more within 70 mile radius. **Transportation:** full service at airport; two railroads; port and barge facilities. **Contact:** Industrial Development Department, Mississippi Power Co. (601) 864-1211.

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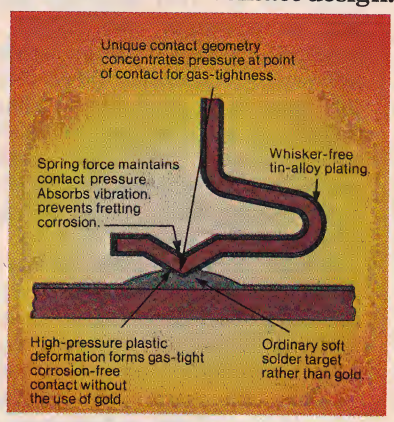

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Mating Force (Lbs.) (Per Contact)	0.445	0.477	0.463
Contact Withdrawal Force (Oz.) (0.008 Blade) 0.5 Oz. Min.	1.120	3.280	2.332
Insulation Resist. (5000 Meg's Min.) 600 VAC for 1 Min.	$>9\times10^4$	$>2\times10^6$	–
Contact Resistance (1 Amp)	5.240	6.670	5.639
GROUP 2			
C.R. After Vibration & Mechanical Shock	3.800	5.170	4.335
Contact Withdrawal Force (Oz.) (0.008 Blade)	0.710	2.930	2.065
Durability (50 Cycles)	3.800	5.200	4.379
Contact Withdrawal Force (Oz.) (0.008 Blade)	1.480	3.120	2.187
Insulation Resist. (5000 Meg's Min.) 600 VAC for 1 Min.	$>2\times10^6$	$>2\times10^6$	–
GROUP 3			
Initial Contact Resistance	4.750	5.900	5.106
After Corrosive Atmosphere	4.850	5.900	5.120

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tion: regional and national airports. **Recent firms:** Engineering Research, Inc., Decca Marine. **Contact:** William L. McCarty, Committee of 100 (904) 255-0981.

County: Polk

Major attractions: Disney World, Busch Gardens and other famed recreational facilities; right-to-work state; industrial sites available; large labor pool. **Tax incentives:** no state or local personal income taxes; no state ad valorem real or tangible personal property taxes. **Educational facilities:** vocational/technical training; Polk Community College, Florida Southern College. **Transportation:** Port of Tampa, Tampa International and Lakeland Municipal Airports; 14 common carrier truck lines. **Recent firms:** Teltronics, Inc. **Contact:** John M. Hamilton, Lakeland Area Chamber of Commerce (813) 688-8551.

County: Dade

Major attractions: Miami International Commerce Center; readily available labor. **Financial inducements:** municipal bond financing. **Educational facilities:** Florida International University, Miami Dade Community College, Barry College, University of Miami, Lindsay Hopkins Education Center. **Transportation:** Miami International Airport, Port of Miami. **Recent firms:** Toshiba Medical Instruments Div., Topp Electronics, Camex International, Inc. **Contact:** Edna Oelhafen, Joan Spector/Public Relations, Inc. (305) 891-4280.

City: Orlando

Major attractions: low wage rates; attractive living environment. **Financial inducements:** revenue bonds. **Educational facilities:** four universities, two community colleges, five vocational/technical schools. **Transportation:** Orlando International Airport; Barge Port; Seaboard Coastline Rail service. **Recent firms:** Reliance Electric, Qwip Systems. **Contact:** Roy L. Harris, Jr., Industrial Development Commission of Mid-Florida (305) 422-7159.

County: Ocala/Marion

Major attractions: popular museums and amusement parks; good quality of life; right-to-work law. **Tax incentives:** no state ad valorem taxes on real property; no state tangible personal property taxes on household goods; no state inheritance taxes; no state, county or city personal income taxes. **Financial inducements:** revenue bonds. **Educational facilities:** Central Florida Community College; vocational/technical programs. **Transportation:** motor carriers, prop jet service to Orlando. **Recent firms:** Martin Marietta, Antennas for Communications, Microdyne. **Contact:** Allen R. Fish, Industrial Development Council, Ocala, Fla. 32670.

County: Broward

Major attractions: existing electronics industry; sizable labor pool; many support firms for aerospace and electronics industries. **Financial inducements:** revenue bonds; full service banking community. **Educational facilities:** four major colleges, two junior colleges; tenth largest public school system in U.S.; vocational education and electronics training schools. **Transportation:** three international airports; deep sea port with foreign trade zone; two railroads, trucking. **Contact:** John Smolko, Broward Industrial Board (305) 491-3001.

County: Pinellus

Major attractions: low wages; availability of skilled and unskilled labor. **Financial inducements:** revenue bonds. **Educational facilities:** Stetson University, University of South Florida, Eckard College, St. Petersburg Junior College. **Transportation:** Tampa International Airport, municipal airport, St. Petersburg/Clearwater International airport. **Recent firms:** GTE. **Contact:** David Wertell, Economic Development Division, St. Petersburg, Fla. 33731.

EAST NORTH CENTRAL

Wisconsin

State

Major attractions: expanding population and rapidly growing economy; healthy living environment; low cost workers' compensation. **Tax incentives:** no property taxes on machinery and equipment; 90 percent of inventories are exempt from personal property taxes; no property taxes on waste treatment facilities; inventory tax credit. **Financial inducements:** municipal, industrial and revenue bond financing. **Educational facilities:** vocational schools; University of Wisconsin. **Transportation:** Ports of Milwaukee, Green Bay and Superior-Duluth; Mitchell Air Field; Dane County Airport, O'Hare International Airport. **Contact:** Barry J. Uhlenhake, Department of Business Development (608) 266-3222.

County: Sauk

Major attractions: large, trainable labor pool; fully serviced, reasonably priced industrial sites available; cultural and recreational amenities. **Financial inducements:** revenue bonds; local financing options. **Educational facilities:** two-year regional vocational college; two-year University of Wisconsin Center System; proximity to University of Wisconsin's main campus. **Transportation:** four general aviation airports. **Recent firms:** Electri-Wire, Spring Green. **Contact:** James E. Rowe, Sauk County Development Corp. (608) 356-3133.

City: Green Bay

Major attractions: unlimited water supply, ample electricity and gas; four industrial parks; recreational facilities; productive labor; strategic market location; low property costs; low crime rate. **Tax incentives:** machinery and equipment tax exempt; 90 percent personal property tax exemption, full reprieve by 1981; general property tax relief; reduced corporate tax liability for multistate companies. **Financial inducements:** industrial revenue bonds. **Educational facilities:** technical training; St. Norbert College, University of Wisconsin in Green Bay; business and professional schools. **Transportation:** airport; deep water Seaway port; three railroads with ferry service; 28 truck lines. **Contact:** Robert C. Houle, Economic Development Coordinator (414) 497-3761.

Michigan

State

Major attractions: available industrial sites; expanding automotive and machine tool markets; large, diversified labor force; supporting technical services; ample energy. **Tax incentives:** no corporate income tax or franchise fee; no intangibles tax; no local property tax on inventory; tax exemptions for machinery, equipment, raw materials, supplies and services used in production; pollution equipment tax free. **Financial inducements:** tax free revenue bonds; construction financing. **Educational facilities:** network of colleges and universities, including the University of Michigan. **Transportation:** metropolitan, county and municipal airports; railroads; truck lines. **Contact:** Norman L. Berman, Office of Economic Development (517) 373-3550.

County: Genesee

Major attractions: industrial parks; ample energy. **Tax incentives:** 50 percent property tax abatement for 12 years. **Financial inducements:** revenue bonds. **Educational facilities:** University of Michigan Flint campus, Mott Community College; "Community Education" system. **Transportation:** Bishop Airport; rail, expressway. **Contact:** Bill Ayre, Genesee TWP (313) 640-2000.

City: Grand Rapids

Major attractions: social and cultural amenities; relatively low housing costs; pro-business environment. **Tax incentives:** tax relief under Plant Rehabilitation and Industrial Development Districts Law and Commercial Redevelopment Act. **Financial inducements:** economic development corporation bonds. **Transportation:** Kent County International Airport; railroads. **Recent firms:** Belknap Laboratories, Inc. **Contact:** Sandra J. Bender, Grand Rapids Area Chamber of Commerce (616) 459-7221.

Illinois

State contact: Donald L. Duster, Department of Business and Economic Development (217) 782-7500.

Indiana

State contact: Donald W. Moreau, Indiana Department of Commerce (317) 633-4450.

Ohio

State

Major attractions: existing industrial base, including General Motors and Ford; pro-business climate; ample energy. **Tax incentives:** total or partial real and personal property tax exemptions; tax credits on new equipment and machinery; tax increment financing; inventory and work-in-process tax abatements. **Financial inducements:** guaranteed loans; revenue bonds. **Educational facilities:** vocational training; 20 general and technical colleges; 135 public and private universities, including Ohio State and Ballette Memorial Institute. **Transportation:** St. Lawrence Seaway. eight deep water ports on

ment of Energy's solar cell research is a new process for making polycrystalline silicon that would differ from semiconductor-grade material. However, Rose says that because of the several approaches now being considered none emerges most cost-effective, "the materials guys are sitting on their hands waiting for something definitive to happen." Luckily, he notes, Japanese and European poly suppliers aren't: They're "expanding like crazy" and could grab a bigger share of a future booming market.—*J. Tsantes*

GI beats the odds to open new horse-racing theater

Companies eyeing the gaming portion of the growing leisure and entertainment marketplace might consider the recent experience of General Instrument Corp. After seven years of effort, GI finally opened what it claims is the world's first "theater of racing" at the Long Wharf restoration area near New Haven, Conn., late last year.

Called Teletrack, the $8 million closed-circuit TV horse-wagering arena pipes live thoroughbred and harness racing from five New York-area raceways via microwave to a full-color 24 by 32-foot screen in the 155-foot circular stadium.

The project took seven years to complete even though it uses fairly conventional communications interfaces, computer systems and 38 Off Track Betting (OTB) terminals distributed on three levels of Teletrack from GI's American Totalisator Systems Div., which supplies both the Connecticut and New York State OTB networks.

Frank Hickey, General Instrument's chairman and chief executive officer, explains that while it only took a year to find a suitable site and two years to design and construct the project, it took four years to plow through all the interstate regulations necessary to consummate this sort of transaction.

Part of the reason might be that signals from the various racetracks are sent to New York's Empire State Building where they are microwave-transmitted to the Southern New England Telephone building in New Haven. From there the signals are cabled into the Teletrack building.

All wagers placed at Teletrack are pooled with those of Connecticut's OTB system, and odds are based on the off-track consolidation of these pools. As a result, the odds might not be the same as those at the tracks, namely Aqueduct, Belmont, Saratoga, Roosevelt and Yonkers raceways. Bets can be placed at 29 windows in the grandstand area, nine in the clubhouse section and two that service four VIP rooms, used to accommodate group activities. General admission to Teletrack is $2 and $3.50 for the clubhouse.

General Instrument has operated Connecticut's OTB system since its beginning in 1976. The state's OTB betting volume has grown from $74 million in its first year to $114 million in the fiscal year ended August 1979. Teletrack, according to Hickey, is expected to increase the annual betting volume significantly.

For the first four days that Teletrack was in operation, the indoor track averaged a $225,000 per day handle and a 60 percent attendance. GI gets between five and six percent of the handle in addition to income from admission and the concession stand and restaurant located within the arena. GI also receives some income from the 800-car parking lot on the 10.8-acre Teletrack site.

While GI had hoped to have five facilities like Teletrack eventually operating in Connecticut, John A. DeVries, senior vice president, says that negotiations are now at a standstill because the state has imposed a moratorium of one to two years on all new gambling activities in Connecticut.■

State Farm chooses custom IBM system for insurance agents

After evaluating proposals from nine vendors, State Farm Mutual Automobile Insurance Co. signed an agreement with IBM's General Systems Div. for the manufacture of a custom-designed small computer system, the only custom unit proposed to State Farm. Two-hundred agents will participate in the pilot program.

The systems will be installed in late 1980 and early 1981. "After installing 200 systems we'll pause to solve any problems that arise," says State Farm's Norman L. Vincent, vice president, data processing. "We'll be primarily concerned with evaluating our training and support procedures, particularly with distributing data and programs."

When all the bugs are worked out, State Farm will make the systems available to its nearly 14,000 agents on an optional leased basis. Leases will cost between $635 and $800 a month depending on the number of display terminals an agent needs. The systems support from one to five terminals.

"IBM will supply the hardware and the operating system," Vincent says. "We'll develop and supply software applications packages to our agents."

The systems will store policy-holder information so agents can quote rates from the computers without referring to books or tables, as well as information relevant to developing life insurance programs that will cover college expenses and other major financial needs. Vincent says the first applications package will also include a calendar-type tickler file to remind agents of future appointments.

"We didn't require a custom design," Vincent says, "but we think it will drive the cost down because we won't have to pay for general purpose functions we don't need or use."

IBM's ability to deliver service to State Farm's geographically dispersed agents, who will install systems in small towns as well as large cities, was another reason the insurance company chose the manufacturer. Vincent says IBM's proposal offered the best combination of product, price and service.

The computer, called the Echo System, represents the most extensive custom-design work on an entire system done by the General Systems Div. "We've custom-designed special features before," says a spokesman for GSD. "We're in business to meet custom needs and have a department that handles custom designs, but this is the first time we've gone to this length." IBM says it worked for 18 months on the system.

The base Echo System unit has 128k bytes of main memory, and Winchester technology disk storage provides 13.9 megabytes for programs and policy-holder records. The system will also support a serial printer in addition to the display terminals.

IBM's spokesman says the central processor was derived from the Series/1, and the display terminals are "special derivatives" of the model 3101, resembling Teletype terminals and tailored to meet the insurance agents' needs.

Although the first systems won't incorporate any communications capability, Vincent says all of State Farm's central computers are made by IBM, and eventually some type of communications link will be set up, probably over telephone lines.

"Right now, data and programs will be transported on floppy disks and sent through the mail," he says. "Teleprocessing would be too complicated, requiring line management and special software to drive the lines." ■

Delaware Technical and Community College; on-the-job training, vocational/technical education. **Transportation:** Port of Wilmington; Greater Wilmington and Sussex County Airports, Philadelphia International Airport. **Contact:** William J. McDermott, Division of Economic Development (302) 668-4254.

West Virginia

State contact: Lon Hardin, Economic Development Division (304) 348-2234.

Virginia

State

Major attractions: concentration of military installations; good living environment; existing industrial base; growing labor force. **Financial inducements:** revenue bonds; federal programs for financial assistance. **Educational facilities:** vocational/technical education; community colleges; numerous other colleges and universities, including Virginia Polytechnic Institute and University of Virginia. **Transportation:** Ports of Hampton Roads; Dulles International Airport, Washington National Airport, Baltimore-Washington International Airport. **Contact:** Anne L. Geddy, Division of Industrial Development (804) 786-3791.

City: Virginia Beach

Major attractions: mid-East Coast location; third fastest growing city in the U.S.; right-to-work law; moderate climate; ample labor. **Tax incentives:** low tax rates. **Financial inducements:** tax-free industrial revenue bonds. **Educational facilities:** six colleges. **Transportation:** Norfolk International Airport; Ports of Hampton Roads. **Contact:** A. James De Bellis, Department of Economic Development, Virginia Beach (804) 427-4511.

City: Suffolk

Major attractions: fully serviced, reasonably priced industrial sites available. **Financial inducements:** revenue bonds. **Educational facilities:** vocational/technical high school; special industrial training at the college level. **Transportation:** airport; three ports serving Hampton Roads; three national railroads. **Contact:** Thomas N. Waller, Suffolk Industrial Development Authority (804) 934-2303.

North Carolina

State

Major attractions: pro-business environment; plentiful labor; low building costs; existing electronics industry. **Financial inducements:** industrial revenue bonds. **Educational facilities:** industrial training programs; 135 post-secondary educational institutions, including the University of North Carolina, Duke University and North Carolina State University. **Transportation:** five interstate highways; 22 railways; 12 commercial airports; two ports. **Contact:** Charles Heatherly, North Carolina Department of Commerce (919) 733-6003.

County: Alamance

Financial inducements: industrial revenue bonds. **Educational facilities:** Elon College, Technical College of Alamance; 16 colleges and universities within a 50 mile radius, including Duke, Wake Forest, North Carolina State and the University of North Carolina. **Transportation:** Interstate 95; Raleigh-Durham and Greensboro-Highpoint-Winston/Salem Airports. **Contact:** Thomas J. Policastro, Alamance County Office of Economic Development (919) 228-1338.

South Carolina

State contact: Robert E. Leak, South Carolina State Development Board (803) 758-3145.

Georgia

State

Major attractions: low cost-of-living expenses; variety in scenery, recreational activities and lifestyles; experienced manpower; growing population and economy. **Tax incentives:** foreign trade zone reductions of or exemptions from import customs duties; accelerated depreciation on pollution control facilities; inventory, property and sales tax exemptions. **Financial inducements:** industrial revenue bonds; full financial services from banking community. **Educational facilities:** 37 senior and 27 junior colleges; 26 vocational/technical schools. **Transportation:** Atlanta International Airport; two major rail systems; interstate highways; three inland and two deep water ports. **Recent firms:** Allen-Bradley Co., Bradford White Corp., CBS Records, Northern Telecom Canada, GM's Delco Remy Div. **Contact:** Ralph M. Dobbs, Georgia Department of Industry and Trade (404) 656-3570.

County: Chatham

Major attractions: large labor pool; good living conditions. **Tax incentives:** equitable tax structure; five year partial forgiveness program. **Financial inducements:** revenue bonds. **Educational facilities:** Savannah, Armstron State Colleges; Savannah Vocational-Technical School. **Transportation:** Savannah Municipal Airport; full service port. **Contact:** W. Miles Greer, Savannah Port Authority (912) 964-1721.

Florida

State contact: J.K. Hennessy, Division of Economic Development, Florida Department of Commerce (904) 488-6300.

County: St. Lucie

Major attractions: pleasant lifestyle; job training; county industrial park; low cost property. **Tax incentives:** low ad valorem tax rates. **Educational facilities:** Indian River Community College. **Transportation:** St. Lucie County Airport; Port of Fort Pierce; Florida East Coast Railroad. **Contact:** Richard S. Reid, G.O. Team, Inc., Fort Pierce, Fla. 33450.

County: Alachua

Major attractions: good climate. **Educational facilities:** University of Florida, Santa Fe Community College, Job Corp Training Center. **Transportation:** Gainesville Regional Airport, Seaboard Coast Railroad. **Contact:** Charles D. McKeown, Gainesville Area Chamber of Commerce (904) 372-4771.

County: Volusia

Major attractions: low interest financing; low corporate income taxes; warm climate; abundant skilled labor. **Tax incentives:** no personal state income tax. **Financial inducements:** 100 percent revenue bond financing. **Educational facilities:** Embry-Riddle Aeronautical University. **Transporta-**

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four major ports. **Contact:** Frank J. Schrey, Commonwealth of Pennsylvania Department of Commerce (717) 787-6500.

County: Lackawanna

Major attractions: plentiful hydropower and other forms of energy; small community lifestyle. **Tax incentives:** tax exempt IDA financing. **Financial inducements:** second mortgage money at four percent interest rate. **Educational facilities:** five colleges and universities. **Transportation:** Scranton/Wilkes-Barre International Airport; Conrail and D & H Railroads; over 40 truck terminals. **Recent firms:** CA Electronics. **Contact:** Donald Bein, Chamber of Commerce Building (717) 342-7711.

SOUTH ATLANTIC

Maryland

State

Major attractions: high concentration of scientific personnel; a developed industrial base of electronics firms; abundant supply of technical and support labor; pro-business environment; recreational and cultural amenities. **Tax incentives:** no sales or use tax on manufacturing machinery and equipment; manufacturing inventories exempt from property taxes; property tax exemptions or moratoriums on machinery and equipment. **Financial inducements:** low cost tax-free financing through the Maryland Industrial Development Financing Authority; revenue bonds. **Educational facilities:** 32 four-year and 21 two-year colleges; University of Maryland, Johns Hopkins University, George Washington University, Georgetown University, Loyola University. **Transportation:** Baltimore-Washington International Airport, Washington National Airport, Dulles International Airport; Port of Baltimore. **Recent firms:** Amdahl Corp. **Contact:** James G. Belch, Department of Economic and Community Development (301) 269-2945.

County: Prince George's

Major attractions: progressive government; ample energy; available industrial land; plentiful skilled and semiskilled labor. **Educational facilities:** vocational and industrial training; University of Maryland, U.S. Prince George's Community College, Bowie State College. **Transportation:** airports; over 50 motor freight lines; superhighways; Port of Baltimore. **Contact:** Michelle A. Liliestedt, The Prince George's County Government (301) 952-4494.

City: Columbia

Major attractions: abundant labor pool; four industrial parks; excellent housing, medical and recreational facilities. **Tax incentives:** favorable county property tax rate; tax exemption for new manufacturing machinery, equipment and distribution inventories; no utility tax; no personal property tax. **Financial inducements:** industrial revenue bonds; tax free low-cost financing through the Maryland Industrial Development Financing Authority; financial aid for certain training costs. **Educational facilities:** four colleges. **Transportation:** airports; Port of Baltimore; two major interstate highways. **Recent firms:** Hamilton-Avnet, Diplomatic Electronics, Technico, Inc. **Contact:** JoAnn C. Koch, The Howard Research and Development Corp. (301) 992-6000.

Delaware

State

Major attractions: good quality of life; business development assistance; concentration of skilled and semiskilled labor. **Tax incentives:** corporate income tax credits; 10-year moratorium on gross receipts tax; sales use tax exemption on new equipment; no state excise tax; tax exemptions on equipment, machinery, goods-in-transit, inventories and raw materials. **Financial inducements:** revenue bonds. **Educational facilities:** 10 preparatory schools, five colleges; University of Delaware,

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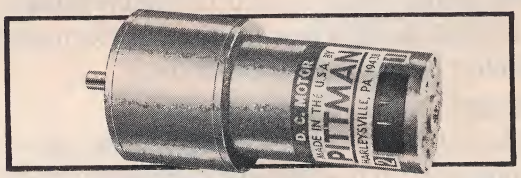

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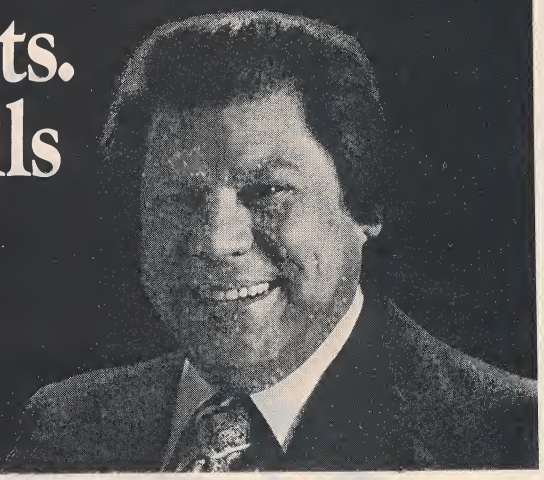

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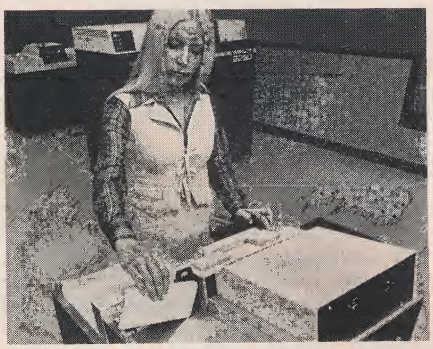

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15. Independent research, test and design laboratory and consultant (only if you are not connected with a manufacturing company)
16. Public administration and military
17. Industrial companies using and/or incorporating any electronic products in their manufacturing, research or development activities
18. Commercial user of electronic equipment
19. Distributor
20. School, university or library
21. Others (explain) _____

6 **My company's annual sales of electronic equipment is (Check only ONE):**
1. ☐ Under $1 million
2. ☐ $1 to $5 million
3. ☐ $5 to $10 million
4. ☐ $10 to $50 million
5. ☐ $50 to $100 million
6. ☐ Over $100 million

7 **My company's purchases of electronic components is (Check only ONE):**
1. ☐ Less than 10% of our electronic sales
2. ☐ 10% to 20% of our electronic sales
3. ☐ More than 20% of our electronic sales

8 **My company's purchases of electronic equipment is (Check only ONE):**
1. ☐ Less than 10% of our electronic sales
2. ☐ 10% to 30% of our electronic sales
3. ☐ More than 30% of our electronic sales

9 Check here if you do not wish to receive promotional mail from ELECTRONIC BUSINESS ☐

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February 1980

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(7)		VP of Purchasing
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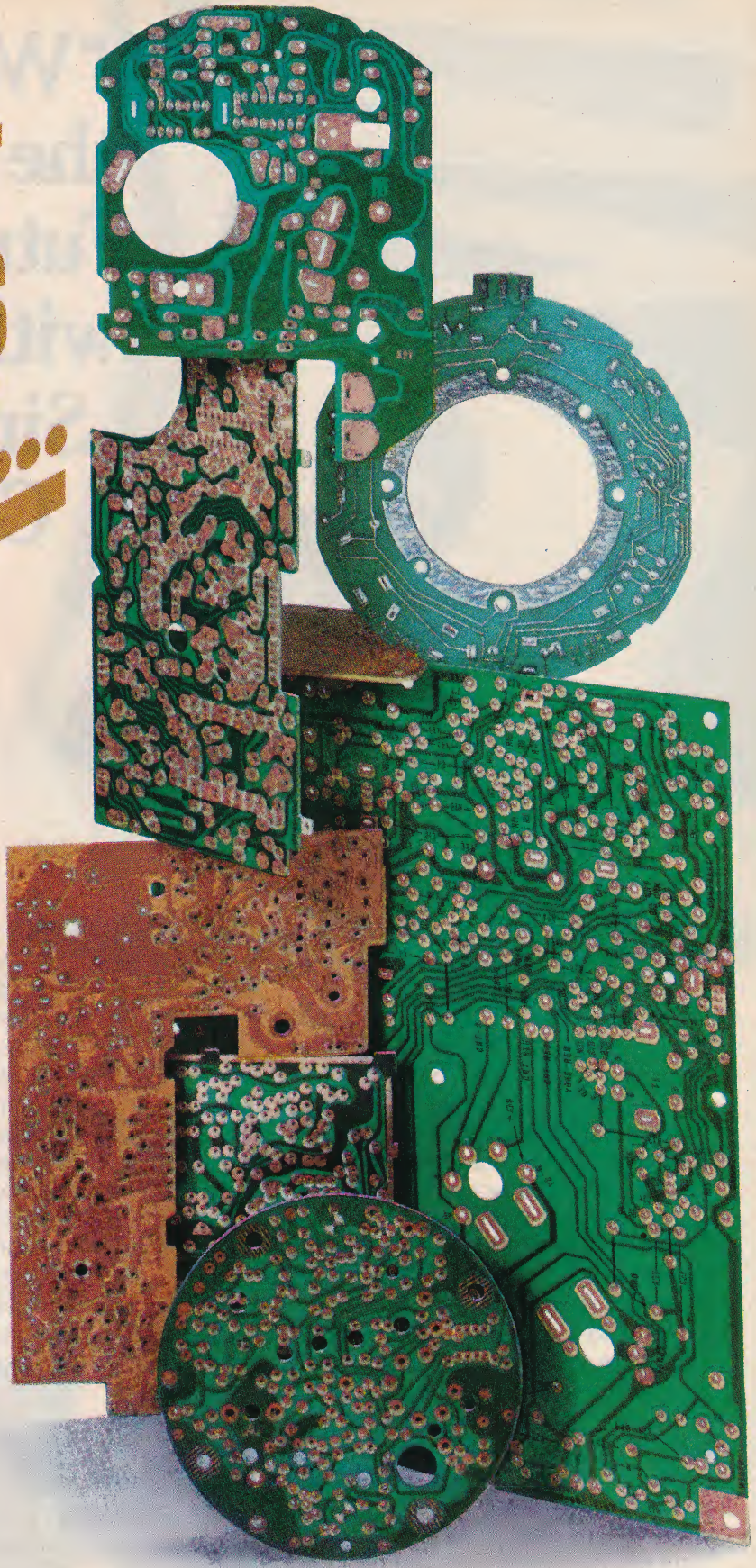

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Phone: 312-343-7004

Guide to U.S. Plant Sites *(continued)*

County: Broome
Major attractions: plentiful cultural and recreational activities; large skilled and semiskilled labor pool. **Tax incentives:** new capital investment credits; one-year write-off of construction and improvement costs; sales and real property tax exemptions. **Financial inducements:** tax-free revenue bonds; several state sources for financial aid. **Educational facilities:** State University of New York, Harpur College, Broome Community College; vocational programs and manpower training. **Recent firms:** Savin Corp. **Contact:** Louis R. Santoni, Broome County Chamber of Commerce (607) 772-8860.

County: Suffolk
Major attractions: Suffolk County Business Center; cooperative county and town governments; abundant land for industrial development; excellent quality of life. **Tax incentives:** up to 100 percent tax abatements for new plants, expansions and property (up to 10 years); investment tax credit; sales tax exemptions. **Financial inducements:** up to 100 percent financing of planning, legal, land, construction and equipment costs. **Educational facilities:** numerous colleges and universities. **Transportation:** Kennedy and LaGuardia International Airports, L.I. McArthur Airport, Suffolk County Airport. **Recent firms:** EIL Instruments, Chyron Star Ind., CEAG Corp., Nov-Tec Ind. **Contact:** Stanley Irwin, Suffolk County Department of Economic Development (516) 979-2929.

County: Essex
Major attractions: fully serviced industrial sites; will build to specifications for lease or sale; ample labor force; low wage rates; attractive mountain/lake living environment. **Tax incentives:** property tax exemptions up to 100 percent for up to 10 years; New York State Job Incentive tax credit. **Financial inducements:** industrial revenue bond and New York State Job Development Authority financing. **Educational facilities:** on-the-job training programs; State University, community college; vocational schools. **Transportation:** Interstate 87; Plattsburgh and Montreal Airports. **Contact:** Barbara R. Boster, Essex County Industrial Development Agency (518) 873-9811.

Region: Southern Tier of New York
Major attractions: a wide selection of industrial sites; economic development assistance. **Tax incentives:** 100 percent 10-year real estate tax abatement; tax credits under the Job Incentive Benefit Program. **Financial inducements:** industrial revenue bonds; various federal and state financial programs. **Educational facilities:** Corning Community College, Elmira College, Elmira Business Institute. **Transportation:** Chemung County Airport; Conrail; interstate highway. **Recent firms:** LCR Electronics, Westinghouse Electric Corp., Facet Enterprises. **Contact:** Andrew W. Pazahanick, Southern Tier Economic Growth, Inc. (607) 733-6513.

County: Steuben
Major attractions: fully serviced industrial sites; skill-training programs. **Tax incentives:** franchise tax abatement; Job Incentive Program tax relief. **Financial inducements:** assistance from County Industrial Development Agency. **Educational facilities:** Corning Community College, Cornell University, Alfred University, Ithaca College. **Transportation:** major rail service plus branch lines. **Recent firms:** Spinoptics Co. **Contact:** Roswell L. Crozier, Corning Crossroads, Inc. (607) 936-8443.

New Jersey
State contact: Harry J. Callaghan, Division of Economic Development (609) 292-2462.

Pennsylvania
State
Major attractions: fully serviced industrial district and parks with many available site locations; plentiful skilled labor supply; market proximity; manpower training; abundant energy; foreign trade zones; healthy business climate. **Tax incentives:** no state inventory tax; low local property taxes; no state real property tax; sales tax exemptions. **Financial inducements:** up to 100 percent financing of land, buildings and machinery; low cost loans; revenue bond and mortgage program. **Educational facilities:** network of state and private colleges, universities, extension programs and community colleges, including University of Pennsylvania, Villanova, Bucknell and Bryn Mawr College. **Transportation:** four international airports;

FOR MORE INFORMATION

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"We're making the Factory of the Future a reality—with Intel® Single Board Computers."

West: "Productivity is on everyone's mind these days. In manufacturing, it's accelerating the trend towards automation of machine control. At Numeridex, we're taking advantage of the demand for improved efficiency by harnessing microcomputer intelligence for computer-aided manufacturing applications.

"Intel Single Board Computers are the technological breakthrough that's made the difference for us. Our special expertise is understanding customers' needs—not designing microcomputers. From the earliest stages of product planning, relying on Intel's fully assembled and tested board computers enabled us to speed up development, conserve capital, and focus our resources on designing the right product for our market.

"Our LC-5000 system for numerical control tape preparation is an example. Its intelligence is based on the Intel iSBC 80/20-4™ Single Board Computer, providing features and capabilities never before available to the numerical control market. Smart machines like the LC-5000 are the tools our customers need to achieve high productivity.

"Starting with fully debugged microcomputer hardware meant we could concentrate on application software. That's where our real proprietary value is, anyway. With our limited experience, though, we might not have succeeded without the software development tools Intel provides. The Intellec® Microcomputer Development System and RMX/80™ Real-time Multitasking Executive software framework made it easy to write specific application-oriented modules. That's another way Intel helps companies like Numeridex gain the market advantage with microcomputers."

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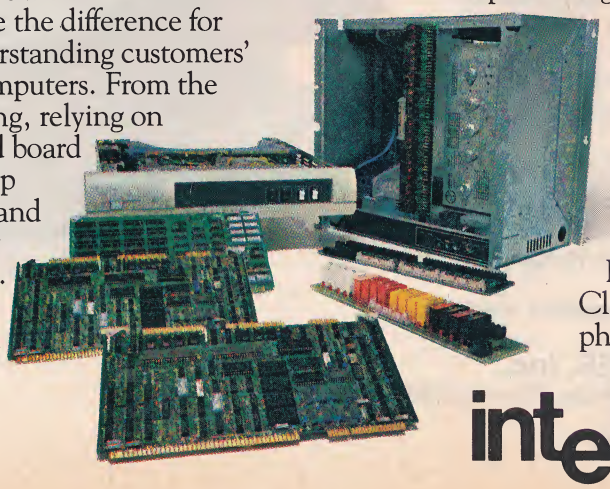

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site, says a spokesman for the firm.

And it looked at them as objectively as possible. "We note the important ingredients in the recipe," says Rousseau, "set standards and find cities that meet those requirements." And after considering numerous locations and what they have to offer, "the process boils down to one thing: We have a need that we try to fill as logically as we can for each particular facility."

Hewlett-Packard goes through much the same process but adds "an awful lot of talking to unions, city fathers, local governments and newspapers," says a company spokesman. "We have a lot to offer the cities we set up in, and we don't want to locate where people don't want us," he points out, adding that a good political climate that cuts red tape is also very important.

"We want to be assured of adequate drainage, sewage, power and roads," he says, noting that HP has taken options on sites in North Carolina and Puerto Rico and plans to build on property acquired in Washington and Colorado.

Other electronics firms continue to scout the country for sites. Over the years their requirements won't likely change, but as popular states like Texas attract more industry, factors like tax, living and labor conditions will. And as they do, the search for plant sites that meet the needs of fast-growing electronics firms will become harder and harder, says Fantus' Kraus, forcing more careful decision-making and closer scrutiny of trade-offs.—*R.B. Swartz*

Guide to U.S. Plant Sites

FOR MORE INFORMATION

To receive more information on advertisers in this section, see the reply card on page 115.

NEW ENGLAND

Rhode Island

State

Major attractions: good quality of life; market proximity; large trained labor pool; competitive wages; abundant energy supply; site availability. **Tax incentives:** phased elimination of property taxes; sales tax exemption on machinery and equipment; investment tax credit; provision for one-year write-off of expenditures for R & D facilities. **Financial inducements:** guaranteed mortgage financing; tax exempt revenue bonds and 100 percent financing. **Educational facilities:** three public and eight private colleges including Brown University. **Transportation:** T.F. Green Airport; local and interstate truck services; deep water ports. **Recent firms:** Raytheon, Electro-Films, Inc., Rosenthal Metcream Corp. **Contact:** John A. Iemma, R.I. Department of Economic Development (401) 227-2601.

Connecticut

State

Major attractions: Mystic Seaport; over 90 state parks and forests; museums and theaters; manpower training; choice site availability. **Tax incentives:** no state or local personal income taxes; no local sales taxes; no manufacturers inventory tax; no corporate net worth tax. **Financial inducements:** industrial revenue bonds; industrial mortgage insurance. **Educational facilities:** over 50 colleges and universities, including Yale, Trinity, Wesleyan and Connecticut College. **Transportation:** ports in New Haven, New London and Bridgeport; Bradley International Airport. **Contact:** James Musante, Connecticut Department of Economic Development (203) 566-3748.

Massachusetts

State

Major attractions: excellent quality of life; foreign trade zones; concentration of universities; large trained labor pool; established electronics industry. **Tax incentives:** local inventory, equipment and goods-in-process tax exemptions; local sales and use tax exemptions; investment tax credit. **Financial inducements:** mortgage insurance and industrial revenue bond financing. **Educational facilities:** Harvard University, Boston University, M.I.T., Northeastern University, Tufts University, Babson College, Boston College, Wellesley College. **Transportation:** Logan Airport; Port of Boston; trucking services. **Contact:** Ernest Lucci, Massachusetts Department of Commerce and Development (617) 727-3218.

New Hampshire

State contact: Paul Guiderson, State of New Hampshire Office of Industrial Development (603) 271-2591.

City: Concord

Major attractions: existing industry; growing work force; favorable business climate; skilled labor; ample energy; Airport Industrial Park. **Tax incentives:** no general income, sales or use taxes; no tax on inventories, work-in-process and process machinery. **Financial inducements:** tax-free industrial development bonds. **Educational facilities:** New Hampshire Technical Institute; six colleges, including Dartmouth, Colby-Sawyer and University of New Hampshire. **Transportation:** Concord Municipal Airport. **Recent firms:** Sprague, Northeast Electronics (Northern Telecom). **Contact:** W.D. Barrell, Economic Development Department (603) 224-9937.

Maine

State contact: Hadley P. Altass, State Development Office (207) 289-2656.

County: Oxford

Major attractions: pro-business environment; industrial sites available. **Tax incentives:** no local sales or income taxes. **Educational facilities:** Hebron Academy, Bowdoin College, Bates College, Colby College, University of Maine; state vocational training complex. **Transportation:** freight carriers; Oxford County Airport, Lewiston Airport. **Contact:** Harvey L. Wiley, Oxford Hills Area Development Corp. (207) 743-2425.

Vermont

State contact: Elbert G. Moulton, Economic Development Department, Agency of Development and Community Affairs (802) 828-3221.

MIDDLE ATLANTIC

New York

State contact: Michael E. Woods, New York State Department of Commerce (212) 949-9340.

County: Clinton

Major attractions: low cost labor; low electricity rates; low land cost in County Industrial Park. **Tax incentives:** New York State Tax Forgiveness. **Financial inducements:** up to 100 percent financing. **Educational facilities:** State University of New York at Plattsburgh, Clinton Community College; B.O.C.E.S. **Transportation:** Clinton County Airport. **Contact:** Francis A. Lapham, Clinton County Area Development Corp. (518) 561-8800.

County: Oneida

Major attractions: low land cost; Oneida County Industrial Park. **Tax incentives:** tax abatement program. **Financial inducements:** up to 100 percent financing on land, buildings, machinery and equipment. **Educational facilities:** Utica College, Hamilton College, Colgate University, State University of New York Upper Division College, Mohawk Valley Community College; vocational programs. **Transportation:** Oneida County Airport. **Contact:** Roger P. Potocki, Oneida County Industrial Development Corp. (315) 736-0888.

(Continued)

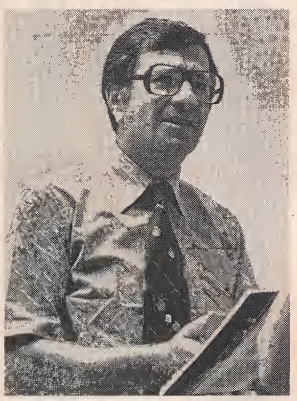
The ELECTRONIC BUSINESS 100

Industry leaders swap positions as they cope with slower growth and signs of maturation

Fewer newcomers entered the list, but more exchanging took place among the top 100 positions. Data reveal high capital investments, slowing sales growth and an intensified labor crunch.

This year's examination of the top 100 U.S. electronics companies affirms the constantly evolving nature of the electronics industry. As its markets change, as the top companies become less purely electronic and as acquisitions restructure company formats, the industry is getting harder to identify. But the list of the top 100 companies and their financial performance last year undermine some widely held notions about the electronics business.

"I expected better patterns than I saw emerge from this year's list," says Jerry Wasserman, senior member of the information systems group at Cambridge, Mass.-based Arthur D. Little, Inc., which supplied the financial information. "But what became immediately evident is that the microprocessor truly has arrived, and the computer is being subsumed."



ADL's Wasserman: "Are we heading toward maturity?"

Also evident, says Wasserman, is that the industry has other concerns besides sales growth. "Profit is becoming increasingly important and is badly needed for capital investment," says Wasserman. Because sales growth rates are slowing, net income is increasing, purely electronics companies are often acquired by nonelectronics companies and investment is high, Wasserman concludes that the industry just might be maturing without management's realization.

Leaders of the industry switch seats

Although there were fewer newcomers to this year's list than to last year's, more companies were repositioned among the top 100 spots. But once again IBM heads the list, and its long lead will prevent its displacement for some years to come.

Out of the other 99 companies, only 10 maintained the same positions they held last year. Twenty-nine companies moved ahead with the greatest jump of 28 positions by General Signal, due in part to its acquisition of Leeds and Northrup. Fifty-four companies dropped in rank, with the largest drop of 17 steps by E-Systems, partly because of telecommunications consulting work done in Iran.

This year's list also includes seven new names: Dart Industries, which acquired P.R. Mallory; GK Technology, formerly General Cable; Johnson Controls, which acquired Globe Union/Centralab; Medtronic; Northern Telecom, which bought Data 100; Oak Industries; and Tandy Corp. Only three companies were actually displaced this year: Pertec Computer, Soundesign and Telex.

Continued on page 45

Performance of the ELECTRONIC BUSINESS 100

Electronic revenues ($ billion)	$115.9
Sales ($ billion)	$350.6
Net income ($ billion)	$21.0
Weighted averages:	
Cost of sales (mfg. cost as % of sales)	67.3%
Sales per employee	$59,722
Net income per employee	$3504
R&D as % of sales	3.5%
Return on equity	16.8%
Return on investment	7.9%
5-year compound growth rate for sales	12.2%
5-year compound growth rate for net income	12.9%
Capital expenditures — % change from prior year	35.6%

Five-Year Sales Growth (compounded rate)

The Top 10	%	Electronic rank
Data General Corp.	48.1	61
Datapoint Corp.	46.8	77
Intel Corp.	43.6	58
Storage Technology Corp.	39.6	70
Wang Laboratories, Inc.	38.2	66
Digital Equipment Corp.	33.7	18
Memorex Corp.	29.1	40
National Semiconductor	27.5	34
EG&G, Inc.	26.2	100
Management Assistance, Inc.	25.9	82
The Bottom 5		
Westinghouse Electric Corp.	3.2	22
Mohawk Data Sciences Corp.	1.1	89
Sanders Associates, Inc.	−0.2	94
Singer Co.	−0.5	39
Zenith Radio Corp.	−0.6	29

Managing resources

U.S. Plant Sites

Selection trends turn West

Electronics firms look to fertile new territories like Washington State for possible plant sites.

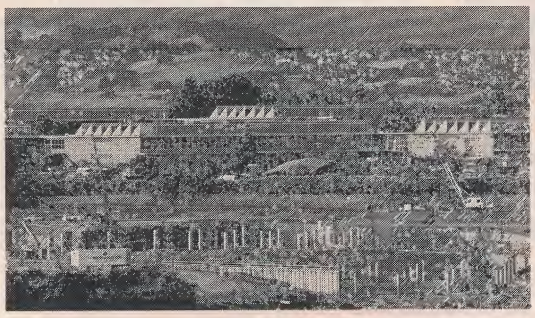
California, once the king of plant site set-ups, has lost its allure because of rocketing real estate costs and labor shortages. Now electronics firms looking for likely plant sites are turning to Texas, Washington State, Phoenix and Colorado.

According to Robert L. Kraus, a vice president at New York-based Fantus Co., a location consulting firm, electronics manufacturers are particularly concerned with plentiful labor and attractive wage rates. Other considerations that weigh heavily include low tax and utility costs, cultural and recreational amenities that aid recruitment, ample educational facilities and easy access to transportation.

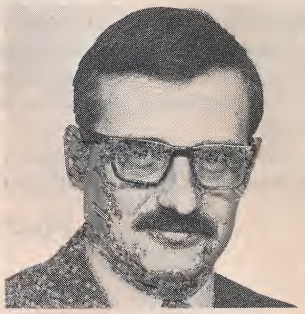
But Kraus notes that electronics firms have more flexibility in choosing plant sites than do other companies. "When a mining company finds a mine, it has no alternative. It has to locate at that site." So although they have other requirements, electronics firms can settle almost anywhere because "the nature of the products—especially components—makes market proximity relatively unnecessary and transportation a minimal part of manufacturing cost."

Thus states that offer inducements attractive to electronics manufacturers might attract so many that they become saturated, says Kraus, who adds that large influxes of companies eventually raise wages as well as property and construction costs as competition for needed resources escalates.

Paul Hoff, vice president of finance at Computer Automation in Irvine, Calif., agrees. His company opened a 9000-square foot engineering and naked mini manufacturing facility in Richardson, Texas, in 1977 "because the overall political climate and attitude toward productivity is better in Texas than in California."



(A)



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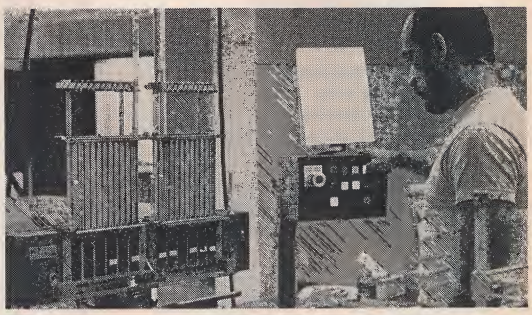

(D)

Deciding where to go *can be a trying ordeal or a short, sweet affair. Nevertheless, many factors always come into play when fast-growing electronics firms need to make a move.*

(A) ***HP's*** *478,000-square foot, $30 million new world headquarters takes shape beside its present Palo Alto, Calif., complex.*

(B) ***Honeywell's Rousseau:*** *"We note the important ingredients in the recipe, set standards and find cities that meet those requirements."*

(C) ***Computer Automation's Hoff:*** *"The general attitude and political climate in Texas encourage productivity rather than consumption."*

(D) ***Storage Technology's*** *plant in Ponce, Puerto Rico, is one of the most automated of new plants.*

The package makes it

However, other factors also came into play, notes George Dashiell, corporate vice president and general manager of Computer Automation's Commercial Systems Div. Winning out over other locations considered such as Portland, Phoenix, Alabama and Dallas, Richardson offered a particularly attractive combination of good blue and white collar labor markets, an existing community of electronics firms, no inventory or personal income taxes, easy access to air transportation and considerably lower leasing costs than in California.

Moreover, says Dashiell, because housing costs are reasonable and quality of life good, "people were happy to relocate and we were able to build a very effective engineering organization in a short period."

The elapsed time from search to start-up was also very short—two months. Familiar with Texas because the company has other facilities in Dallas, it saw what it wanted and grabbed it.

No magic

But for most other firms, the search process is longer and can range from 18 months to seven years, says an IBM spokesman, who adds that two recent openings in Tucson, Ariz., and Charlotte, S.C., "met the needs of the business for adequate land, readily available transportation and a quality of life that attracts professional employees to these areas."

"There's no magic involved," says John Rousseau, manager of corporate real estate for Minneapolis-based Honeywell, which has recently opened new facilities and expanded existing ones nationwide.

Now building a plant to manufacture thermostats, smoke detectors and light commercial energy-management products in Albuquerque, N.M., the company looked at about 200 factors as a standard procedure before settling on a

The ELECTRONIC BUSINESS 100

Rank '79	Rank '78	Company	Electronic Revenues ($ Millions)	Total Sales ($ Millions)	Total Net Income ($ Millions)	Cost of Sales (Mfg. Cost as % of Sales)	R&D % of Total Sales
1	1	IBM	$20,895.	$21,076.1	$3,110.6	26.9%	6.0%
2	3	ITT	7,294.	15,261.1	661.8	74.6	2.4
3	2	Western Electric	6,665.	9,521.8	561.2	73.5	5.5
4	4	General Electric	4,015.	19,653.8	1,229.7	70.8	2.7
5	5	Honeywell	3,547.8	3,547.8	181.5	56.1	5.3
6	8	Xerox	3,246.	5,901.9	464.9	29.4	5.3
7	6	GTE	3,224.6	8,723.5	627.2	69.5	1.5
8	7	RCA	3,088.	6,600.6	278.4	70.2	2.1
9	9	Sperry Rand	2,718.1	4,179.3	224.1	57.2	5.7
10	10	Texas Instruments	2,549.9	2,549.9	140.3	68.5	4.4
11	12	Motorola	2,219.7	2,219.7	125.2	59.7	6.0
12	15	NCR	2,196.	2,610.5	193.7	43.3	5.3
13	11	Burroughs	2,142.4	2,422.3	253.4	38.1	5.9
14	16	Raytheon	2,030.	3,239.3	150.0	79.8	2.1
15	13	Litton	2,028.	4,086.4	188.9	72.3	1.7
16	14	Hughes Aircraft	1,900.	N.S.	N.S.	N.S.	N.S.
17	17	Rockwell	1,892.	5,668.8	209.1	78.4	1.1
18	19	Digital Equipment Corp.	1,804.1	1,804.1	178.4	54.3	7.7
19	18	United Technologies	1,779.	6,265.3	234.1	70.3	7.0
20	20	Hewlett-Packard	1,751.0	1,751.0	153.0	43.3	8.9
21	22	Control Data Corp.	1,550.0	1,846.4	84.5	62.4	5.8
22	21	Westinghouse Electric	1,496.	6,663.3	311.3	77.0	2.3
23	24	General Motors	1,378.	63,221.1	3,508.0	81.4	2.6
24	36	Ford Motor Co.	1,344.	42,784.1	1,588.9	87.5	3.4
25	23	N.A. Philips	1,288.	2,184.0	68.0	73.0	1.4
26	26	TRW	1,259.	3,787.3	174.2	71.2	1.4
27		Tandy Corp.	1,215.5	1,215.5	83.2	44.1	N.S.
28	25	Bendix	1,186.	3,625.5	129.6	78.3	1.4
29	27	Zenith	980.0	980.0	23.3	82.0	N.S.
30	29	Boeing	963.	5,463.0	322.9	82.7	5.1
31	33	Tektronix	786.9	786.9	77.2	51.1	7.7
32	31	Avnet	782.0	1,028.1	54.5	71.4	N.S.
33	28	Grumman	730.	1,455.5	21.9	84.4	0.9
34	41	National Semiconductor	719.7	719.7	34.3	64.8	9.4
35	32	Sony Corp. of America	700.	N.S.	N.S.	N.S.	N.S.
36	30	Harris	686.1	982.1	63.1	62.9	4.0
37	34	3M	677.2	4,661.7	563.0	49.2	4.4
38	38	McDonnell Douglas	654.	4,130.3	161.1	80.8	4.1
39	37	Singer	639.	2,469.2	60.3	62.8	1.2
40	45	Memorex	633.3	633.3	41.9	54.3	3.7
41	39	Martin Marietta	632.	1,758.3	136.0	72.2	0.4
42	43	Perkin Elmer	610.	733.0	50.3	54.3	5.9
43		Northern Telecom	587.	N.S.	N.S.	N.S.	N.S.
44	46	AMP	561.	801.1	97.7	53.5	9.2
45	40	General Instrument	550.6	550.6	34.1	72.1	1.3
46	44	Fairchild	550.4	550.4	24.8	67.8	10.2
47	42	Teledyne	539.	2,441.6	248.5	71.6	1.3
48	58	Matsushita Electric	520.	N.S.	N.S.	N.S.	N.S.
49	71	E.I. DuPont de Nemours	500.	10,584.2	787.0	69.5	3.6
50	47	Lockheed	487.	3,485.0	55.0	85.9	1.9

Electronic revenue figures rounded off to millions are estimates.
N.S. — Not Supplied
— Loss

Electronic Market Forecasts

Security market to triple

U.S. security systems markets, spurred by more stringent fire regulations, insurance incentives and the growing use of electronics in security products, will triple by 1990 to hit $23 billion.

While protective and investigative services will continue to represent 50 percent of the market through 1990 and grow 10.4 percent a year, electronic monitoring and detection equipment will grow faster at a 14.7 percent annual rate, often replacing higher cost guard services.

Electronic access control—a deterrent to computer crime, which costs business as much as $40 billion a year—will grow 17 percent annually, faster than any other security product. And tight control required by facilities like nuclear power plants, chemical processing operations and oil drilling platforms will generate additional demand.

A slew of high quality, low cost intrusion and fire alarm devices from an increasing number of manufacturers will feed demand from the fast-growing single family home market, which will rise from $260 million in 1978 to $1.5 billion by 1990.

—"Private Security Systems," Predicasts, Inc., Cleveland, Ohio.

Purchased security equipment
($ millions)

	1978	1990	% annual growth
Protective services	3520	11,600	10.4
Guard & investigative	2680	8900	10.5
Central station	460	1500	10.4
Armored car	380	1200	10.1
Deterrent equipment	1430	4700	10.4
Fixed security	425	1800	12.8
Locking devices	630	1550	7.8
Electronic access control	90	600	17.1
Security lighting	285	750	8.4
Monitoring & detection equipment	890	4600	14.7
Electronic alarm systems	260	1450	15.4
Monitoring & surveillance equipment	530	2800	14.9
CCTV	100	350	11.0
Fire control equipment	650	2100	10.3
Chemical fire extinguishers	200	550	8.8
Automatic sprinklers & other	450	1550	10.9
Total	$6490	$23,000	11.1
Market shares			
Industrial & transportation	3000	9600	10.2
Financial & commercial	2240	8645	11.9
Institutional	640	2265	11.1
Consumer	610	2490	12.4

Source: Predicasts, Inc.

Energy management market to double by 1988

The market for building energy management and facilities control systems, $165 million in 1978, will more than double to $350 million by 1988 as energy conservation becomes a primary national concern.

Markets for building automation systems—encompassing facility controls like temperature/humidity, security alarming, mechanical equipment and maintenance monitoring as well as energy usage control—will shoot from $125 million in 1978 to $240 million by 1988. And cumulative sales will hit $2 billion by that time.

Building control systems market
($ millions)

End user	1978	1988
Office	40	70
Commercial	28	67
Industrial	30	54
Hospital/medical	22	48
Educational	16	35
Special purpose/other	21	48
Total	$157	$322

Source: Frost & Sullivan

Sales of power management systems, which are limited to electrical energy usage control, will also benefit from soaring energy costs and growing numbers of conservation-minded manufacturers. This market, $40 million in 1978, will nearly triple to $110 million by 1988, and cumulative sales will reach $800 million.

Heavy demand from commercial, industrial, office and other end users, whose building operations account for 20 percent of U.S. energy use and whose "conservation potential" is as high as $5 billion a year, will benefit temperature control manufacturers, which had 66 percent of 1978's market, as well as computer/control, building equipment and energy control system makers.

—"U.S. Building Control Systems Technology and Markets," Frost & Sullivan, Inc., New York.

Laser markets poised for growth

Laser markets, fueled by falling prices and widening customer bases, are about to take off. Some 70 laser-oriented firms stand to benefit from outstanding gains in certain sectors:

- The carbon-dioxide laser market will double between 1978 and 1983 to hit $67 million, and nitrogen laser markets will rise from $3.5 million to $7.5 million during this period;
- The market for HeNe lasers, used in nonimpact printing, point of sale scanners and video disk players, will increase from $20 million in 1978 to $50 million by 1983;
- The solid-state laser market, $11 million in 1978, will more than double to $25 million by 1983, and over this period, Nd:YAG laser markets will grow 18 percent a year;
- Semiconductor laser markets, now $5.5 million, will climb 35 percent a year to $20 million in 1983 and $60 million in 1986.

Reprographics applications, formerly a sleeper market, are opening up with the advent of nonimpact laser printers by IBM, Xerox and others. Sectors within this applications arena that will see outstanding growth between 1978 and 1983 include telecopiers, which will grow 317 percent; platemakers, 400 percent; line printers, 338 percent; and Washfax Type, 4400 percent.

—"U.S. Laser Technology and Markets in Commerce and Industry," Frost & Sullivan, Inc., New York.

Flourishing printer markets

Worldwide shipments of serial impact printers, rising 29 percent a year, will hit 1.18 million units by 1983. Revenues, however, will grow at a more modest pace because OEMs are expected to reduce prices four to six percent annually.

Through 1983, fully formed character printer technology will dominate fast-growing word processing markets, and product changes that double solid character printer speeds to 80 to 90 characters per second and drop prices to under $1000 will boost sales 35 percent annually.

Low-speed solid character printer sales, propelled by heavy demand for personal and small business computers, will also grow fast, as will sales of matrix impact printers, which will be used increasingly in text-editing applications as technological improvements result in better resolution and print quality.

—"The Markets for Computer Printers," Creative Strategies International, San Jose, Calif.

Productivity				Compound Growth Rate (last five years)			
Total Sales per Employee ($ Thousands)	Net Income per Employee ($ Thousands)	Return on Equity	Return on Investment	Total Sales	Total Net Income	Capital Expenditures (% change over prior year)	FY ending
$64.75	$9.56	23.1%	15.0%	13.9%	14.6%	51.3%	12/78
40.27	1.75	12.0	4.7	8.4	4.9	21.2	12/78
59.14	3.49	16.0	9.2	6.2	11.9	N.S.	12/78
49.02	3.07	18.7	8.2	11.2	16.0	29.4	12/78
41.10	2.10	13.1	6.4	8.2	13.3	48.5	12/78
56.35	4.44	16.7	8.3	14.6	9.1	38.6	12/78
40.76	2.93	14.6	3.9	11.3	12.2	18.1	12/78
55.94	2.36	17.4	5.7	9.2	8.7	39.9	12/78
47.86	2.57	13.8	6.0	9.8	14.8	54.5	3/79
32.45	1.79	16.6	9.2	14.7	11.0	78.6	12/78
32.64	1.84	14.1	7.6	9.1	8.8	35.8	12/78
42.11	3.12	14.9	7.5	7.5	21.9	21.4	12/78
44.33	4.64	13.3	8.7	13.9	16.9	40.2	12/78
50.93	2.36	20.3	7.3	15.3	26.6	56.9	12/78
52.59	2.43	20.3	6.6	6.2	66.6	28.4	7/79
N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	6/79
49.64	1.83	15.4	5.9	12.3	10.6	25.7	9/78
41.00	4.06	15.9	9.6	33.7	32.1	25.0	6/79
41.16	1.54	13.2	5.8	22.3	32.1	30.0	12/78
40.75	3.61	15.3	10.5	21.2	24.7	42.0	9/78
35.90	1.64	8.0	4.3	14.6	7.0	62.2	12/78
47.00	2.20	12.8	4.9	3.2	14.0	17.4	12/78
75.35	4.18	20.0	11.5	12.1	7.9	55.6	12/78
84.47	3.14	16.4	7.2	13.2	11.9	40.7	12/78
59.18	1.84	13.3	5.8	24.6	15.2	28.5	12/78
40.57	1.87	16.9	7.5	11.8	12.9	22.4	12/78
58.72	4.02	40.0	13.7	16.0	24.8	18.1	6/79
47.70	1.71	13.9	6.4	10.4	13.3	25.5	9/78
43.17	1.03	8.5	4.8	– 0.6	– 15.8	14.3	12/78
67.28	3.98	21.9	9.0	10.4	44.5	59.4	12/78
36.96	3.62	19.2	12.0	23.7	29.3	84.0	5/79
82.91	4.39	17.7	10.1	12.5	13.8	22.7	6/79
55.98	0.84	10.2	3.6	6.1	5.2	23.9	12/78
22.25	1.06	20.4	8.9	27.5	15.9	76.7	5/79
N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	10/78
50.62	3.25	18.2	7.7	14.4	28.2	54.6	6/79
54.86	6.63	21.7	13.8	12.9	13.8	22.1	12/78
58.55	2.28	13.4	5.2	6.6	4.5	50.9	12/78
30.48	0.74	12.0	4.2	– 0.5	– 8.6	23.1	12/78
57.13	3.78	20.3	8.6	29.1	– 18.8	61.3	12/78
62.80	4.86	15.7	8.7	9.1	18.9	26.3	12/78
53.47	3.67	17.8	9.0	21.9	24.0	58.4	7/79
N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	12/78
47.33	5.77	24.8	14.8	13.9	16.5	35.2	12/78
22.94	1.42	14.8	8.0	5.3	19.6	45.1	2/79
21.22	0.95	12.0	5.8	9.4	– 9.5	N.S.	12/78
50.24	5.11	28.7	16.0	10.9	30.6	41.9	12/78
N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	11/78
80.10	5.96	16.5	9.8	14.9	6.1	18.4	12/78
56.67	0.89	19.6	3.3	4.8	31.3	21.0	12/78

TI's voice products were designed to augment or replace output devices currently used in industry and transportation.

learning opportunity. "We take a highly flexible approach," says Computalker partner and founder Lloyd Rice. "Our system requires more time and effort, but it produces better speech."

Good homework

The CT-1, now being replaced by an updated model, was the product of good marketing homework—a textbook case of how to design a product for a specific submarket. It was intended as a development tool for voice synthesis experimenters to whom education is at least as much an objective as the developed software. Introduced when the personal computer market consisted almost entirely of hobbyists and experimenters, the CT-1 was perfectly adapted to that market. It was offered with editing software that displays various speech parameters on a video terminal and allows those parameters to be easily manipulated.

Computalker's Rice believes that fixed-vocabulary systems like TI's will do better in the immediate future, but that open-ended, programmable systems have the best long-term prospects. Voice quality is improving rapidly with advances in hardware, software and understanding of the human voice, he says, and "overall, there are more applications for open-ended systems."

Among the applications Rice sees as incompatible with fixed-vocabulary synthesizers are open data base systems—like Kurzweil's text reader—and teaching machines. In an interactive educational environment where the dynamic nature of the course material governs what is spoken, only programmable systems will do, he says. "Often 500 to 1000 words will take care of 90 percent of use, but the remaining 10 percent of terms required are the most critical and necessitate a programmable system."

Switch hitter

Whether the big market is for fixed, formant-based systems, as TI believes, or for programmable, phoneme-based systems, as Rice believes, one company is not waiting for the issue to be decided: Telesensory Systems, Inc. in Palo Alto, Calif., is developing a text reader competitive with Kurzweil's that covers all the bases. According to Alan Yatagai, TSI's program manager for speech systems, the company's first production units, expected before year end, will use a proprietary two-chip synthesizer that can process both linear predictive coded formants and phoneme-derived data. Moreover, says Yatagai, "it will be able to switch instantly from one bit stream to the other."—*A.R. Kaplan*

***Votrax' Leonard Magnuson** believes his products cover the widest span of price, voice quality and applications.*

The ELECTRONIC BUSINESS 100

Rank '79	Rank '78	Company	Electronic Revenues ($ Millions)	Total Sales ($ Millions)	Total Net Income ($ Millions)	Cost of Sales (Mfg. Cost as % of Sales)	R&D % of Total Sales
51	35	Gould	$452.	$1,869.9	$101.0	66.8%	3.9%
52	48	Corning Glass Works	451.	1,251.7	104.4	64.0	5.1
53	54	Schlumberger	450.	N.S.	N.S.	N.S.	N.S.
54	49	AM International	437.	754.5	9.0	57.8	2.1
55	53	Beckman Instruments	426.7	426.7	29.3	49.5	7.8
56	52	Lear Siegler	413.9	1,327.3	63.3	74.5	1.1
57	50	Varian Associates	401.4	401.4	11.8	65.1	6.2
58	61	Intel	400.6	400.6	44.3	44.3	10.4
59		Dart Industries	399.0	1,820.1	126.6	59.4	0.6
60	88	General Signal	390.0	1,029.9	60.7	67.1	2.9
61	67	Data General	380.0	380.0	40.3	45.9	10.1
62	56	Ampex Corp.	379.9	379.9	18.2	69.2	5.8
63	59	Siemens	370.	N.S.	N.S.	N.S.	N.S.
64	55	General Dynamics	361.	3,205.2	– 48.1	90.2	1.3
65	60	Bunker Ramo	325.0	383.2	18.8	70.8	2.3
66	72	Wang	321.6	321.6	28.6	37.6	5.1
67	73	Amdahl	320.9	320.9	48.2	44.7	7.7
68	64	Cutler-Hammer	318.	N.S.	N.S.	N.S.	N.S.
69	65	Emerson Electric	308.	2,177.5	169.7	64.6	2.1
70	77	Storage Technology	300.4	300.4	26.8	54.9	6.3
71	62	Eastman Kodak	300.	7,012.9	902.3	52.1	5.5
72	66	Union Carbide	300.	7,869.7	394.3	70.9	2.0
73	68	GK Technologies	294.5	848.0	25.3	78.4	1.2
74	57	E-Systems	284.8	340.4	12.7	79.9	N.S.
75	63	Northrop	270.6	1,829.8	88.4	81.1	3.0
76	69	LTV	246.	5,260.5	20.0	92.9	0.4
77	78	Datapoint	232.1	232.1	25.2	40.5	7.8
78	70	AMF	216.	1,316.4	44.9	70.4	1.5
79		Medtronic	214.	224.1	23.5	35.9	7.9
80	99	Walter Kidde & Co.	211.	1,878.5	68.7	73.4	0.8
81	79	Eltra	206.	1,019.9	47.9	74.3	0.3
82	82	Management Assistance	205.2	205.2	16.2	48.9	1.8
83	76	Superscope	200.	205.1	– 15.5	74.1	N.S.
84	87	Bally Mfg.	195.	305.8	31.7	63.9	0.9
85	75	Foxboro	190.	395.7	32.5	52.8	6.3
86	80	Textron	181.	3,230.6	168.1	75.5	2.7
87		Johnson Controls	180.	599.9	37.2	70.5	1.2
88	89	Tracor	180.	191.2	7.8	72.0	2.4
89	85	Mohawk Data Sciences	178.3	178.3	9.6	37.8	4.1
90	81	Sybron	172.0	616.9	28.0	59.7	3.1
91	86	A.B. Dick	171.5	N.S.	N.S.	N.S.	N.S.
92		Oak Industries	171.	192.2	4.9	69.9	2.5
93	98	Bell & Howell	169.	567.5	12.3	66.9	4.2
94	90	Sanders Associates	168.3	168.3	14.4	71.9	3.0
95	92	Dataproducts	163.6	163.6	14.2	59.8	8.2
96	94	Reliance Electric	160.	966.3	64.6	68.1	3.8
97	91	CTS	152.1	164.8	10.8	74.2	3.8
98	100	Cincinnati Milacron	152.	633.7	33.2	71.4	2.6
99	84	Cramer Electronics	150.7	150.7	– 1.3	77.1	N.S.
100	95	EG&G	149.	440.5	16.7	78.6	1.7

Electronic revenue figures rounded off to millions are estimates.
N.S. — Not Supplied
— Loss

EPROMs is offered for $1280. The board contains an empty slot for a future 128k-bit ROM that will replace all the EPROMs, leaving the EPROM space available for enhancements. TI currently provides a master vocabulary of 20,000 coded words to choose from, which the company claims is "sufficient for all but the most esoteric applications." Additionally, the spokesman points out that all offered vocabularies include the letters of the alphabet, which allows users to create some of their own words like "D" + "crease" and "N" + "crease" (decrease and increase).

Not badder; better

Leonard Magnuson, Votrax director of marketing and sales, is also after what TI calls self-contained applications, e.g., voltmeters, airplane cockpits and microwave ovens. He predicts a voice response market of between $1½ to $2 billion by the end of the decade, of which "Votrax expects to capture a significant share."

Magnuson says that in some cases artificial-sounding speech is an advantage. He cites a Bell Laboratories study showing that speech with certain non-human base frequencies cuts through noise and better captures audience attention, a definite plus for auto-paging public address systems. "Some of our industrial customers deliberately create a monotonic electronic voice sound by disabling the inflection controls," Magnuson notes.

An application Votrax has been very successful with as well as one that has given its developers considerable personal satisfaction is voice prosthesis, or aids for the speech impaired. The company's Phonic Mirror HandiVoice is a portable calculator-like device with 128 keys, each with four levels. Pressing the keys, which can be labeled with words, pictures or symbols, generates phonemes, words or whole sentences ("I am hungry"; "Please help me"). The product is marketed by HC Electronics, a subsidiary of American Hospital Corp.

Votrax is also a major supplier of voice synthesis systems for time-sharing, educational and personal computer applications. Used with Control Data's "Plato" time-shared educational computer network, one Votrax unit serves all of those applications simultaneously.

A $399 system marketed by Radio Shack for use with its TRS-80 personal computer is another Votrax product.

Personal computers account for the largest share of programmable, phoneme-based synthesizers, and one of the largest suppliers of that market is Computalker Consultants of Santa Monica. The company's $425 Model CT-1 (a version for use with the Radio Shack TRS-80 costs $595) requires considerable skill to use well, but the challenge appeals to users who see it as a

Productivity				Compound Growth Rate (last five years)			
Total Sales per Employee ($ Thousands)	Net Income per Employee ($ Thousands)	Return on Equity	Return on Investment	Total Sales	Total Net Income	Capital Expenditures (% change over prior year)	FY ending
$48.04	$2.60	14.7%	7.1%	24.7%	33.5%	30.1%	12/78
42.43	3.54	14.1	8.5	5.8	8.2	28.6	12/78
N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	12/78
37.72	0.45	4.0	1.7	6.9	96.4	28.2	7/79
34.41	2.37	15.9	7.0	16.9	31.6	57.1	6/79
52.95	2.52	20.9	8.9	15.1	25.8	32.1	6/79
35.31	1.04	7.2	3.5	10.7	11.7	30.5	9/78
36.69	4.07	21.6	12.4	43.6	36.9	130.0	12/78
43.49	3.02	13.6	7.1	12.9	15.2	19.6	12/78
41.09	2.42	12.2	7.1	12.3	26.2	23.7	12/78
35.08	3.72	21.0	11.6	48.1	43.0	84.9	9/78
31.03	1.51	13.7	6.0	6.5	34.6	33.1	4/79
N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	9/78
41.57	−0.62	−6.8	−2.7	14.3	3.6	28.7	12/78
38.70	1.90	13.5	6.9	5.7	17.7	23.6	12/78
41.59	3.70	24.2	9.4	38.2	42.5	115.9	6/79
109.90	16.50	33.4	16.9	N.S.	N.S.	125.7	12/78
N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	12/78
46.43	3.62	19.3	13.0	18.4	17.5	30.3	9/78
46.24	4.13	24.2	8.7	39.6	43.7	127.2	12/78
56.19	7.23	18.6	13.3	11.7	6.7	16.7	12/78
69.42	3.48	10.8	5.0	14.9	6.3	25.6	12/78
35.33	1.06	10.6	4.1	12.6	6.9	27.4	12/78
31.62	1.18	13.7	7.4	15.4	27.7	31.4	12/78
58.65	2.83	24.8	9.5	21.2	50.1	66.6	12/78
73.06	0.28	3.6	0.5	4.9	−12.3	12.9	12/78
45.82	4.98	19.7	15.0	46.8	60.8	68.8	7/79
46.09	1.57	11.8	5.0	6.5	−4.9	26.6	12/78
55.31	5.79	17.2	11.4	23.4	29.8	21.3	4/79
39.97	1.46	12.1	5.3	14.0	12.7	20.5	12/78
45.39	2.13	12.2	6.5	7.8	8.1	N.S.	9/78
51.29	4.04	32.0	12.4	25.9	40.4	76.1	9/78
89.19	−6.73	−31.5	−7.8	11.5	9.5	19.5	12/78
54.61	5.66	23.0	11.9	19.8	19.2	95.7	12/78
36.98	3.04	13.7	9.3	19.0	33.6	33.4	12/78
46.15	2.40	16.5	8.5	11.7	10.8	28.7	12/78
26.31	1.63	12.7	5.9	19.0	32.6	65.2	12/78
28.12	1.14	19.5	7.1	18.7	28.5	56.3	12/78
44.57	2.39	15.2	5.2	1.1	−8.5	44.2	4/79
39.65	1.80	12.3	5.8	8.9	5.2	22.2	12/78
N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	12/78
20.53	0.52	8.4	3.0	10.3	1.8	77.0	12/78
46.10	1.00	6.6	3.2	7.4	−8.5	21.9	12/78
38.29	3.45	22.1	11.0	−0.2	−5.4	34.3	7/79
41.41	3.59	16.2	9.5	16.5	24.6	70.5	3/79
44.49	2.98	20.0	10.5	14.8	22.8	23.3	10/78
20.20	1.32	11.2	9.5	3.6	−2.0	24.8	12/78
47.37	2.48	16.0	6.9	11.3	27.9	22.8	12/78
123.85	−1.03	−6.8	−2.0	4.4	−14.4	2.6	9/78
29.85	1.13	26.3	12.8	26.2	29.9	22.6	12/78

How to save a million dollars and improve your product at the same time.

A million dollars is, actually, a conservative estimate.

If you are using a number of standard chips in your product, and come to us for a custom MOS/LSI circuit, you'll probably find that your savings are considerably higher.

Most of our customers have. Even those with production runs of less than 20,000 a year.

What's interesting is that when many of them came to us, savings were not uppermost in their minds. They wanted to make their products smaller, lighter, more versatile, or more reliable.

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Where the savings came from. Obviously, switching from a number of IC circuits to a single MOS/LSI circuit eliminates the cost of all those other circuits.

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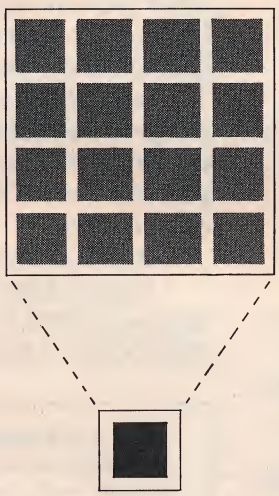

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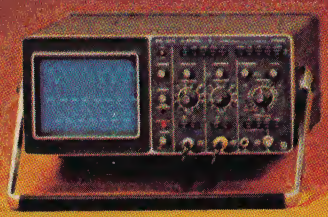
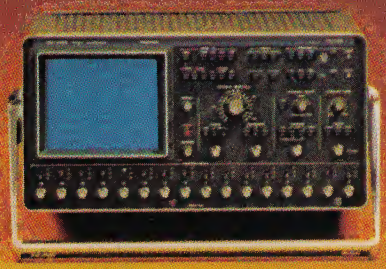


PM3212 25MHz Dual Trace Scope

PM3226 15MHz Dual Trace Scope



PM3500 100MHz 16 Channel Logic Analyzer

PM3266 100MHz Storage Scope

PM3263 100MHz Microprocessor-Equipped Scope with Digital Delay

PM3243 50MHz Multiplier/Storage Scope

PM3214 25MHz Delayed Time Base Scope with Alternate Time Base Display

PM3540 10MHz Logic State Analyzer with 25MHz Dual Trace Scope

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But what have we done for you lately? We just introduced a 100MHz logic analyzer. There isn't a faster one on the market. And when there is, *we'll* design it, manufacture it, and stand behind it! Right here in the USA! Now you know why Philips should be *your* scope company.

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PLUS 2 and FORTRAN in compatibility mode. That's more than any other 32-bit minicomputer system offers you.

With tools like these to work with, your gains in programming efficiency can be enormous.

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"VAX/VMS gives you a total of seven languages to choose from—more than any competitive system on the market."

3. VAX is a new level of system integration. While other software systems were designed around existing hardware, Digital's software and hardware engineers worked together on VAX from the very beginning. The result is the most efficient virtual memory system on the market.

The VAX/VMS operating system gives you a virtual memory capacity of four gigabytes. And a main memory capacity that can go clear up to eight million bytes.

So you can write your programs without worrying about complex overlays, or spending time fighting with a limited memory space. Because each process can be up to 32 million bytes long—largest capacity in the minicomputer industry today. VAX/VMS automatically handles the memory mapping, providing high-performance techniques such as "page pooling" and "page clustering." In addition, many of our innovative paging algorithms are built right into the firmware for maximum execution speeds.

"With a virtual memory capacity of four gigabytes, VAX/VMS can handle your longest programs."

4. VAX/VMS gives you complete control over system resources. You can lock part or all of a program into main memory for the highest possible performance. You can also set priorities on 32 different levels—the first 16 for real-time so you can strictly separate real-time applications from others. You can even control user privileges to the point where it's practically impossible for a low-level user to interfere with people doing high-level work.

All these management tools are incredibly easy to work with, so you can spend your time planning and implementing instead of struggling with the system.

And if you have a lot of programs to convert, you'll be surprised how easy VAX/VMS makes that, too.

"Now about that offer..."

We think it's well worth 60 minutes of your time to discover what VAX can do for your development work. If you agree, just send the coupon to me, Larry Wade, at the address below.

Is one hour enough time to prove everything we've said here? Frankly, I doubt it. But it should be plenty of time for you to prove to yourself that VAX software is way ahead of the competition.

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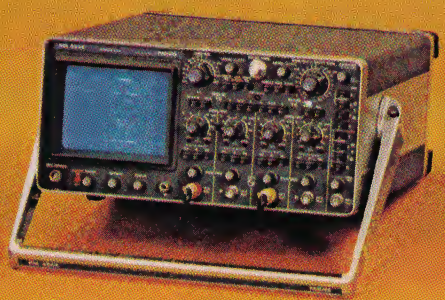
PM3207 15MHz/5mV Dual Trace Scope

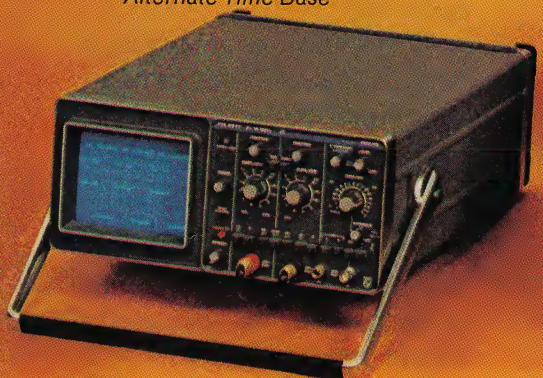
PM3216 35MHz Single Time Base Scope

PM3262 100MHz Dual Trace Universal Scope with 3 Channel Display and Alternate Time Base



PM3244 50MHz 4-Trace Scope

PM3265 150MHz Scope with 100MHz Analog Multiplier



PM3211 15MHz Dual Trace Scope

PM3234 10MHz Dual Beam Storage Scope

PM3233 10MHz Dual Beam Scope

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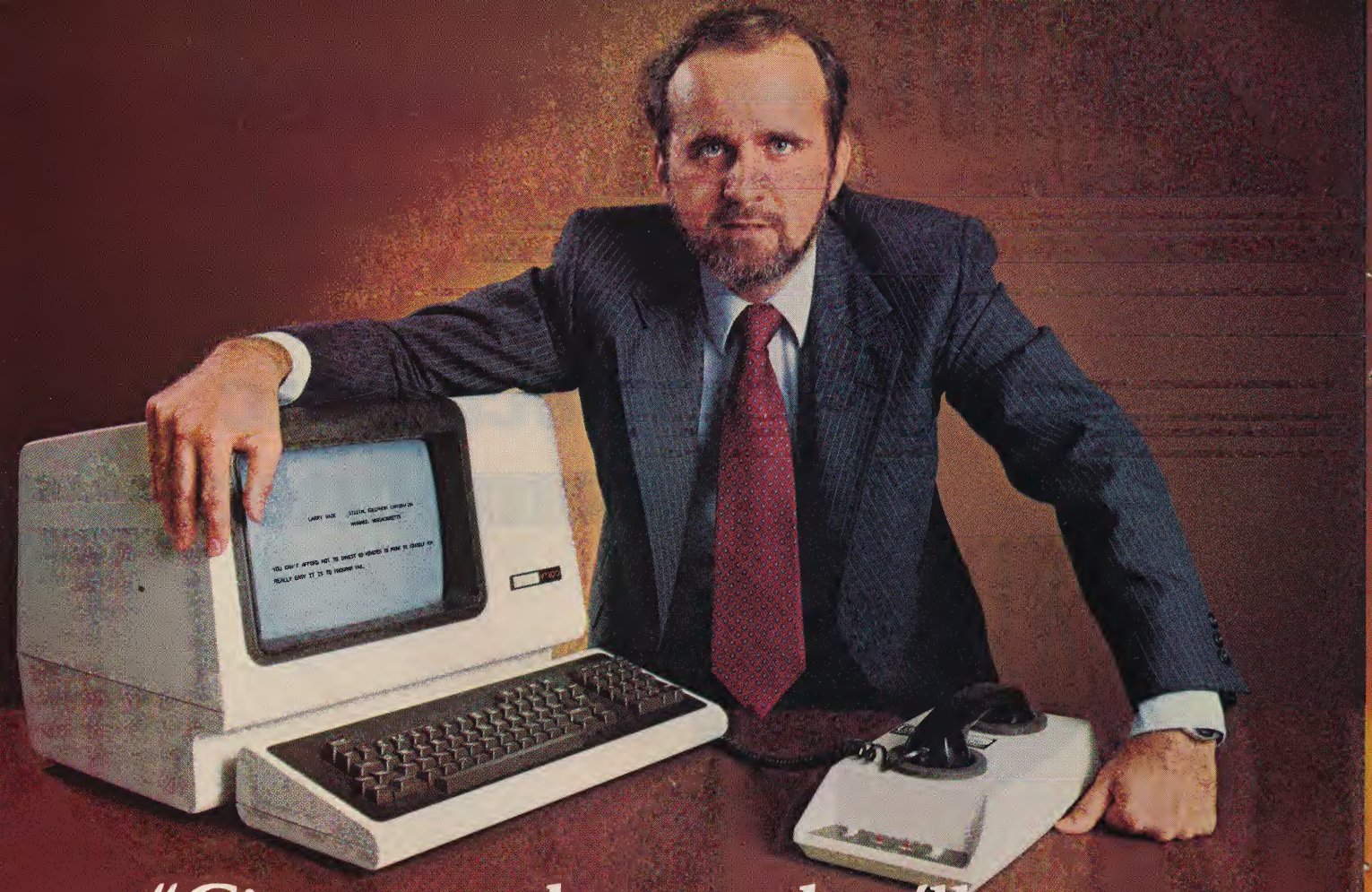

"Give us one hour and we'll prove you can program a VAX faster than any other 32-bit OEM computer."

Larry Wade, Marketing Manager, Technical OEM Group, Digital Equipment Corporation.

We want to prove to you the programming power of the VAX-11/780, and what it can do for your development time.

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"Four good reasons you should dial up a VAX."

1. You start with more software. VAX gives you more software than any other 32-bit minicomputer, so there's less system development work for you to do.

The VAX/VMS operating system is composed of a number of functional layers around a highly efficient real-time executive. This means you can either interface at the I/O level, or you can use our highly versatile file management system to set up sequential, random or multi-key ISAM file structures.

And VAX/VMS gives you unequalled networking and communications capabilities, with other Digital systems and with competitive mainframes.

2. You have to work with our programming tools to believe them. With VAX/VMS, all your programming, editing and debugging take place right at the terminal, whether you're programming interactive or batch applications. Our symbolic debugger even lets you interactively monitor and control your programs and variables—using the *same* symbolic names and data formats you created in the source program.

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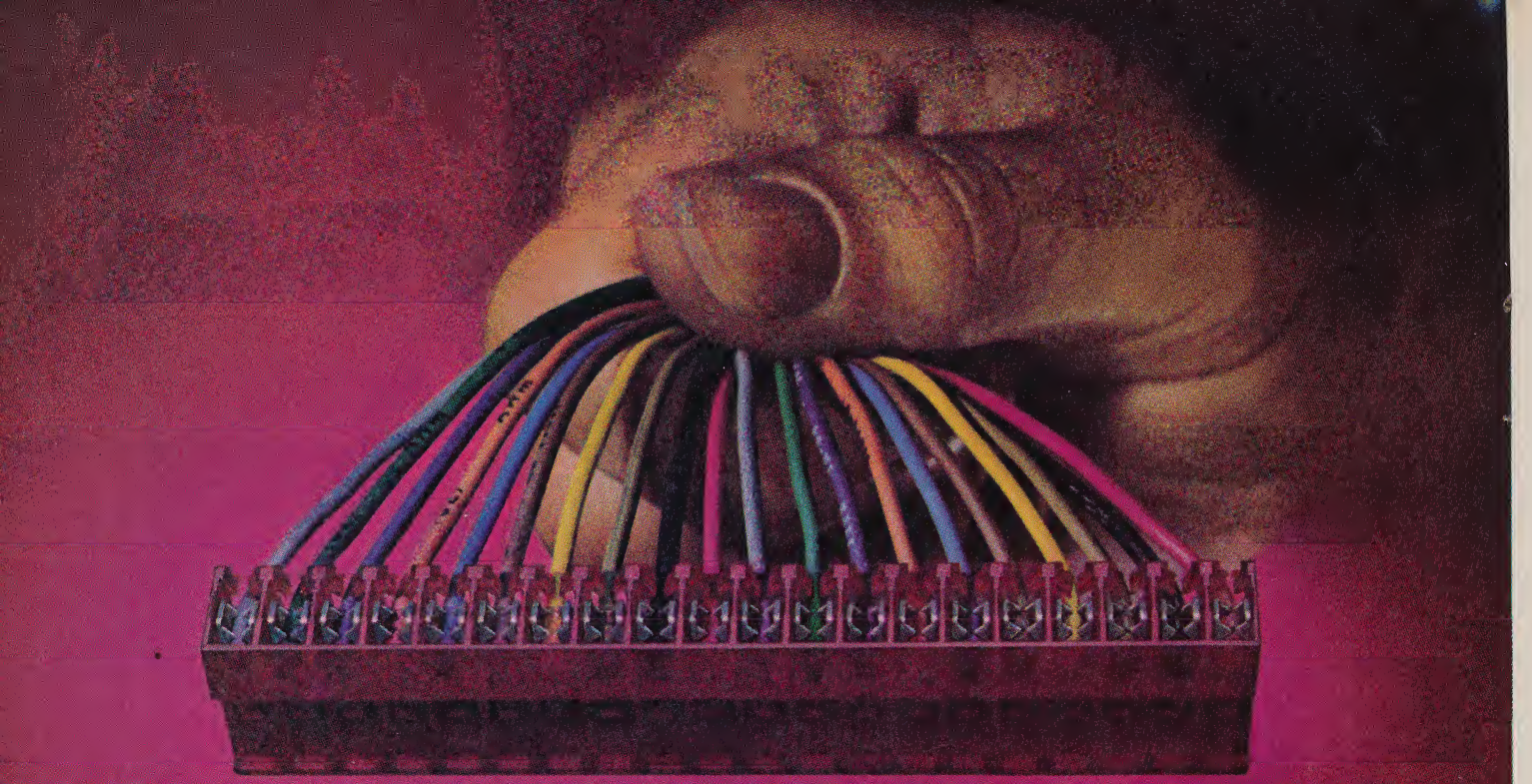
And you can choose from five languages: FORTRAN IV-PLUS, COBOL, PASCAL, BLISS, or MACRO. Plus PDP-11 BASIC-.



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Early Involvement.

At AMP, we call this approach to solving our customers' problems "Early Involvement." It's our better way. And it's what makes an AMP connector worth so much more than the 15¢ saving.

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Or write to AMP Incorporated, Harrisburg, PA 17105.

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Experience. Competence. Total capability.

In a word — reliability.

Isn't that what you really want in your supplier of precious metal materials?

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Including both electronic equipment and component manufacturers and distributors, the list was compiled from an examination of annual reports and SEC 10-K forms dated on or before July 31, 1979. For companies on calendar years, figures were taken from annual reports ending December 31, 1978.

With the exception of Hughes Aircraft, the list includes only publicly held companies and therefore excludes potential top 100 electronics firms like Allen-Bradley and Bourns.

High capital investments and slower growth spell danger

ADL's Wasserman used the list and comparative financial data to conclude that the industry is currently in a transitional stage—defining what it is and where it's going. But too many companies are doing what they've always done: putting technology first, says Wasserman. "The electronics industry thinks it's R&D intensive," he says, and yet the facts show that the top 100 companies aren't spending heavily on research and development. Only 34 companies spent over five percent of sales on R&D.

Instead, much of the spending was on capital equipment. In 90 companies, capital expenditures increased more than 20 percent in one year. The average capital expenditure over the prior year's spending was 35.6 percent. Capital expenditure as a percent of cash flow increased over 50 percent for 71 companies, signifying the increased borrowing pressures the companies are under.

Additionally, while almost half of the companies had five-year compound net income growth rates of over 15 percent, sales of only 34 of the 100 companies grew at that rate over the past five years. The average of all companies was a 12.2 percent compound five-year sales growth, down from last year's average of 12.5 percent.

The electronics industry also faces labor shortages, and the problem is worsening. Wasserman says, "The shortage of qualified technicians, systems engineers and software experts will force management into stricter allocation of human resources. People might end up being the critical factor, the resource whose scarcity will hurt the industry most."

In almost half the companies, employment increased more than 10 percent. When the average nine percent employment growth among the 100 companies is added to a seven-percent wage increase guideline, the result is 16 percent additional funds drawn for salaries alone.

Given the high interest costs to borrow, the slowdown in growth rates, the increase for wages and the high costs of capital expansion, Wasserman predicts a "potential disaster in the making."

Recycling growth and reassessing priorities are keys

To avoid the disaster, it's become imperative for electronics companies to position themselves and examine the dynamics of evolving new markets, not just the sales dollars they offer, says Wasserman. "The number of real and pseudo opportunities for electronics is so great that companies must decide where to go and what to do," he says. "Electronics firms need to make a tough, hard-nosed analysis of their capabilities and personalities."

Although many opportunities exist for electronics in consumer, office equipment, industrial, communications, data processing, automotive, military and space applications, each of those markets differs in its stage of maturity, competitive positions, industry changes and trends. Wasserman notes that the opportunities in the automotive market, for instance, are often offset by the strict demands for product reliability and performance, commitment and profitability by the automobile manufacturers. "Sure, the opportunities are there," says Wasserman, "but you have to pay."

To survive, companies during the next decade will have to change with the industry, recognize its potential maturation and reassess their priorities and markets. Wasserman says Texas Instruments exemplifies a company that sharpens its marketing approach and discipline with internal competition among

Five-Year Net Income Growth
(compounded rate)

The Top 10	%	Electronic rank
AM International, Inc.	96.4	54
Litton Industries, Inc.	66.6	15
Datapoint Corp.	60.8	77
Northrop Corp.	50.1	75
Boeing Co.	44.5	30
Storage Technology Corp.	43.7	70
Data General Corp.	43.0	61
Wang Laboratories, Inc.	42.5	66
Management Assistance, Inc.	40.4	82
Intel Corp.	36.9	58
The Bottom 5		
Fairchild Camera & Instrument	– 9.5	46
LTV Corp.	– 12.3	76
Cramer Electronics, Inc.	– 14.4	99
Zenith Radio Corp.	– 15.8	29
Memorex Corp.	– 18.8	40

R&D as a % of Sales*

The Top 10	%	Electronic rank
Intel Corp.	10.4	58
Fairchild Camera & Instrument	10.2	46
Data General Corp.	10.1	61
National Semiconductor	9.4	34
AMP Incorporated	9.2	44
Hewlett-Packard Co.	8.9	20
Dataproducts Corp.	8.2	95
Medtronic, Inc.	7.9	79
Beckman Instruments, Inc.	7.8	55
Datapoint Corp.	7.8	77
The Bottom 5		
Walter Kidde & Co., Inc.	0.8	80
Dart Industries, Inc.	0.6	59
LTV Corp.	0.4	76
Martin Marietta Corp.	0.4	41
Eltra Corp.	0.3	81

*For some companies, such as distributors like Cramer and Tandy, R&D spending is an irrelevant measure of their performance.

Capital Expenditures
(% change over prior year)

The Top 10	%	Electronic rank
Intel Corp.	130.0	58
Storage Technology Corp.	127.2	70
Amdahl Corp.	125.7	67
Wang Laboratories, Inc.	115.9	66
Bally Manufacturing Corp.	95.7	84
Data General Corp.	84.9	61
Tektronix, Inc.	84.0	31
Texas Instruments	78.6	10
Oak Industries, Inc.	77.0	92
National Semiconductor	76.7	34
The Bottom 5		
Westinghouse Electric Corp.	17.4	22
Eastman Kodak Co.	16.7	71
Zenith Radio Corp.	14.3	29
LTV Corp.	12.9	76
Cramer Electronics, Inc.	2.6	99

Voice synthesizer market develops beyond talking stage

Manufacturers line up behind different technologies, but all expect to be heard.

Talking computers are not new: Banks and telephone companies have used rudimentary voice response systems for more than a decade. But until recently their use was confined to large computer-controlled, multiuser applications that could justify costs that often exceeded $100,000. Today there are toys and games—some priced under $50—that speak more intelligibly, perform more intelligently and have larger vocabularies than many of those early systems.

The current market for speech synthesis systems is probably no more than $20 million worldwide, according to Selig Gertzis, senior consultant at Quantum Sciences in New York. He further estimates that toys, games and experimental systems for personal computers account for well over half that figure. But Gertzis anticipates "at least a doubling of revenues each year for some time" as speech synthesis infiltrates new areas.

Spreading the word

Gertzis' enthusiasm is shared by many observers who also believe the technology behind the new talking toys has opened a gold mine of applications. "For computers to continue improving the quality of our life and work, methodologies for communicating with them must be humanized," says J. Michael Nye, president of Marketing Consultants International in Hagerstown, Md. "The new voice technologies make that possible," he says, "and there are as many applications for them as there are computers."

Unlike first-generation analog voice response systems that worked by concatenating (stringing together) whole words and even phrases prerecorded on magnetic or optical media, the digital voice technologies Nye refers to recall programmed sequences of coded sound patterns (formants) or language elements (phonemes). The way formants or phonemes are reduced and stored in memory as bit patterns and subsequently reconstructed into recognizable speech is known as "synthesis by rule" as opposed to "synthesis by concatenation."

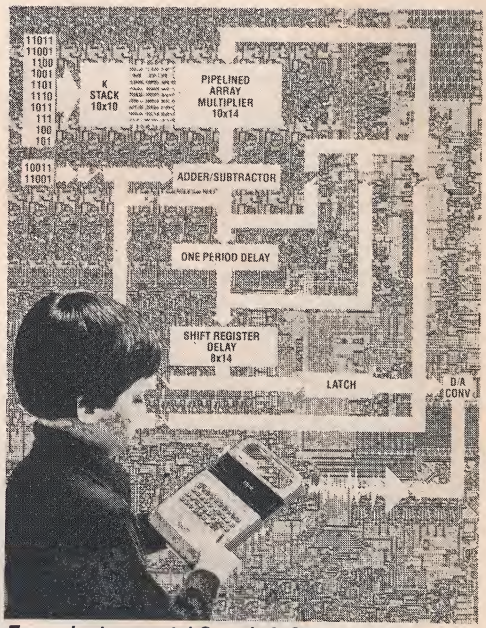
Nearly all of the dozen or so current manufacturers of voice synthesis systems use synthesis by rule procedures, but no two of them implement those procedures in the same way. And because these differences affect system price, size, quality of reproduced speech, extent of vocabulary and ease of use, different manufacturers often find themselves adddressing different markets.

Fixed or open

For example, the technology employed in Texas Instruments' inexpensive and highly popular "Speak & Spell" learning aid is not currently suited for text reading machines of the type produced by Kurzweil Computer Products, Cambridge, Mass., for the blind. TI uses a semi-concatenated formant approach whereby a predetermined ("fixed") vocabulary of spoken words is converted by a statistical filtration process known as linear predictive coding (LPC) into highly compressed code. With this technology, TI can typically store up to 236 highly intelligible and natural-sounding words in 32k bytes of memory.

This approach contrasts with the unrestricted or "open" phoneme-based method used by Votrax, the Troy, Mich., subsidiary of Federal Screw Works. Votrax users can key into memory sequences of phonemes that produce any words. Alternatively, text that can be optically scanned and converted into phonemes can be entered directly into a Votrax system for reconstruction into speech. Votrax has supplied systems for that application to Kurzweil and is currently supplying them to IBM for its audio typing unit for blind typists.

Phoneme-based systems have two weaknesses, however. First, the process of converting words to phonemes, whether performed by an operator or by a computer, is complicated and inexact; words frequently sound unnatural. Second, although the amount of memory required to store the basic phonemes is small, the amount required to access the combinations of phonemes that produce whole words can be large, particularly when subcommands that modify pitch, inflection and timing are included to create more natural-sounding speech.



Texas Instruments' Speak & Spell: *A learning aid for children and a significant achievement for voice synthesis technology.*

Exponents of both the fixed formant and open phoneme schools argue that their systems can overcome their respective liabilities, but the fact remains that the different approaches currently suggest different applications. A Texas Instruments spokesman says TI's design goals were low cost and high intelligibility: "Our voice products were designed to augment or replace output devices presently used in industrial and transportation settings. There can be no argument that for those self-contained applications, our LPC approach is vastly more important than infinitely programmable capabilities."

TI's single-chip synthesizer was developed by its consumer products group and is not available as a component, although TI "probably wouldn't slam the door on an automaker." An industrial board-level product with 180 words in eight 16k-bit

Continued on page 109

Sales per Employee

		Electronic rank
The Top 10		
Cramer Electronics, Inc.	$123,850	99
Amdahl Corp.	109,900	67
Superscope, Inc.	89,190	83
Ford Motor Co.	84,470	24
Avnet, Inc.	82,910	32
E.I. DuPont De Nemours	80,100	49
General Motors Corp.	75,350	23
LTV Corp.	73,060	76
Union Carbide Corp.	69,420	72
Boeing Co.	67,280	30
The Bottom 5		
General Instrument Corp.	$22,940	45
National Semiconductor	22,250	34
Fairchild Camera & Instrument	21,220	46
Oak Industries, Inc.	20,530	92
CTS Corp.	20,200	97

Net Income per Employee

		Electronic rank
The Top 10		
Amdahl Corp.	$16,500	67
IBM Corp.	9560	1
Eastman Kodak Co.	7230	71
3M Co.	6630	37
E.I. DuPont De Nemours	5960	49
Medtronic, Inc.	5790	79
AMP Incorporated	5770	44
Bally Manufacturing Corp.	5660	84
Teledyne, Inc.	5110	47
Datapoint Corp.	4980	77
The Bottom 5		
AM International, Inc.	$450	54
LTV Corp.	280	76
General Dynamics Corp.	−620	64
Cramer Electronics, Inc.	−1030	99
Superscope, Inc.	−6730	83

projects. "Four or five projects compete for funds, and so the best of the lot typically wins," says Wasserman.

To combat the slowing growth rate of the industry, some segments can be recycled back into the growth mode, says Wasserman. And it's out of these segments that the top performers emerge.

Top performers come from profitable niches

Wasserman based his judgement of the top performers on comparative data from the following categories: sales per employee, employment growth, net income per employee, additions to capital expenditures over the year, capital expenditures as a percent of cash flow, R&D as a percent of sales, return on investment and on equity, and five-year compound sales and net income growth rates. The top performers, says Wasserman, are those that are included in at least four of the top 10 lists in these categories.

The winners? Amdahl, Data General, Datapoint, Intel, Storage Technology and Wang. "These companies," says Wasserman, "not only understand the technology but also develop reliable products that address growing, profitable applications, and they've built their names into those niches."

Wang is a particularly good example of an evolving company that is moving into more profitable areas, Wasserman says. "Wang has totally changed in the last 10 years, going from programmable calculators to minicomputers and now to combined word and data processing for the 'office of the future'."

The other profitable niches that Wasserman's top performers exploit are information processing (Amdahl), micro- and minicomputers (Intel and Data General), terminals (Datapoint) and peripherals (Storage Technology).

The list also reveals a lack of leadership from the consumer

Alphabetical index of the ELECTRONIC BUSINESS 100

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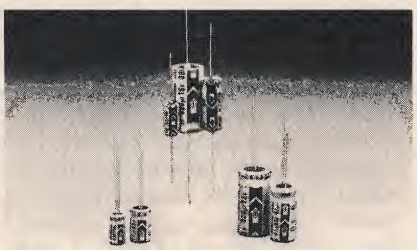

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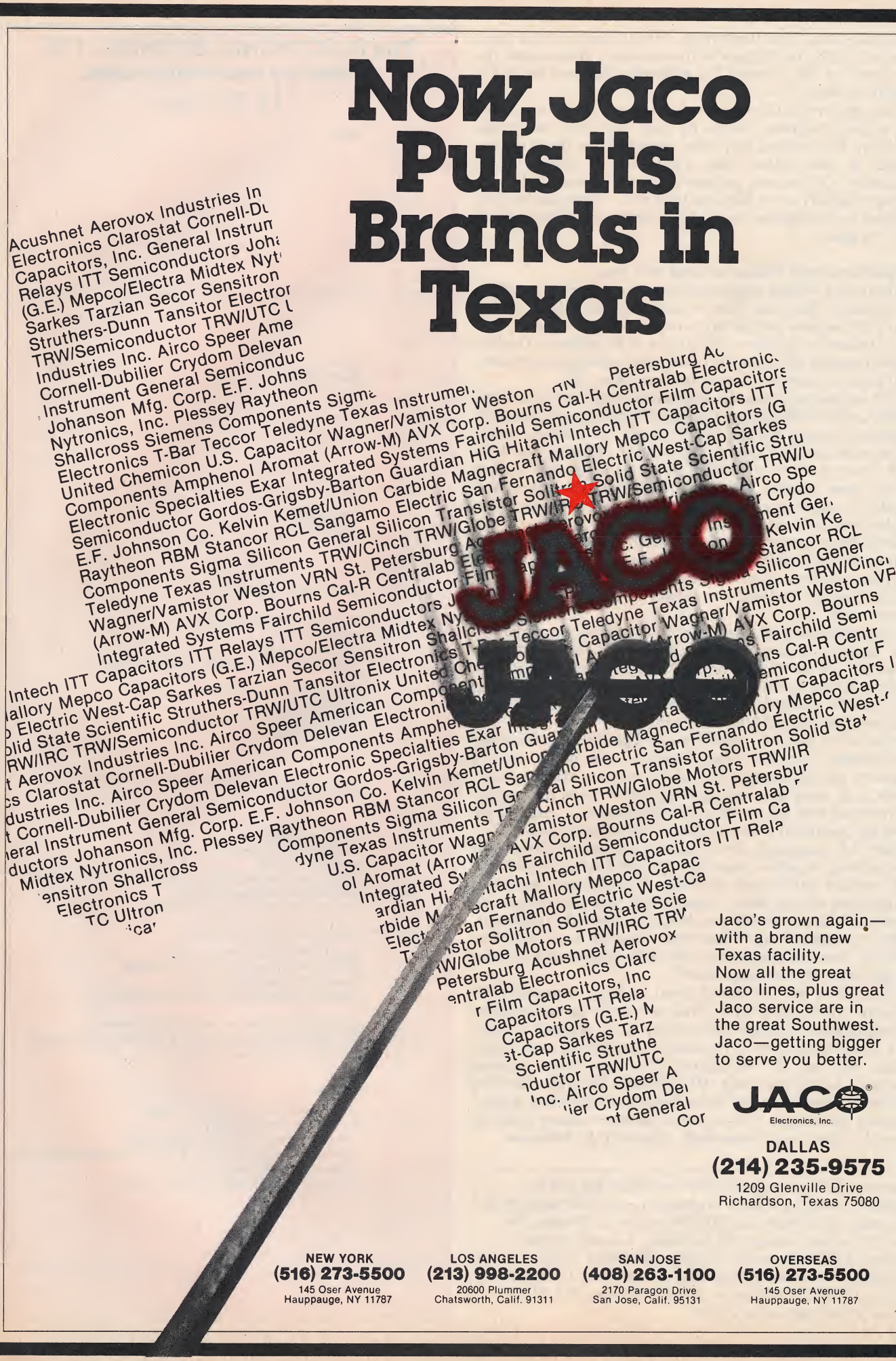

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Computer interconnection applications used $13 million worth of fiber optics last year and will account for $80 million worth by 1984.

weight, installation, corrosion and maintenance are highlighted.

The market's impedances

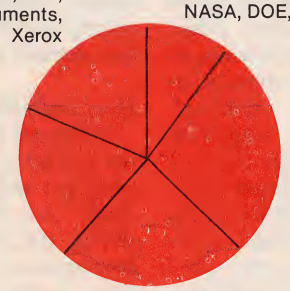
Issues remain to be resolved before the market can reach its potential, however. There are still cost/complexity trade-offs in connectors and couplers and transmission limitations of light-emitting diodes. And it's uncertain whether fiber optic prices will decrease sufficiently for the technology to be economically competitive with copper wire.

Lack of component standardization is also inhibiting market growth, although the gap has partially narrowed in cable sizes. Diagnostic capabilities, second sources and low-cost field connectability—requirements for user acceptance—are still unavailable.

Market analyst William G. Hutchison, president of W.G. Hutchison and Co. Ltd. in Toronto, says that in the near future applications will exploit the clear signals and improved data security that fiber optics provides. "The market isn't waiting for the fiber cable prices to drop but rather for component costs to decrease," he maintains.

Although companies like Hewlett-Packard and 3M that sell data links to end users will help drive down component prices, it will be a few years before the market sees volume sales from computer users. Hutchison says, "Even if fiber optics were cost-effective today, volume demand would still take three to four years."—*D. Domenicali*

U.S. fiber-optic market for computer terminal and sensor interconnection — 1979
($ Millions)



Vertically integrated systems = $2.3
Hewlett-Packard, Honeywell, IBM, Sperry Univac, Texas Instruments, Xerox

Government = $1.3
NASA, DOE, Security, State, Local

OEM = $2.6
Computers, Minicomputers, Process control, Office automation

Military = $3.6
Navy, Air Force, Marines, Army

End User = $3.2
Chemical industry, Utilities, Transportation, Financial systems, Earth stations, Experimenters

Source: Kessler Marketing Intelligence

electronics area, says Wasserman. "I was surprised that there were no really big changes in the consumer area despite the explosions of that market. The consumer is geared for it, but nobody is there."

He suggests that the absence of a consumer presence among the leading positions means no pure consumer electronics company has evolved yet; most companies in that area approach it from either other electronics or nonelectronics businesses. Or, he says, perhaps consumer companies haven't enough visibility yet to stand on their own. "Next year we'll be looking for companies like Coleco, Mattel and Milton Bradley," he adds.

Acquisitions mean change now and next year

This year's list also emphasizes how much acquisitions affect the industry. Revenues from at least three companies on last year's list became part of larger companies' in this year's list: Dart Industries (number 59) bought P.R. Mallory; General Signal (number 60) acquired Leeds and Northrup; and Northern Telecom (number 43) now includes Data 100.

The acquisition trend will also be evident in next year's top 100 list, with Schlumberger (number 53) picking up Fairchild's revenues (number 68) and GEC Chicago, an indirect, wholly owned subsidiary of General Electric Ltd., including sales from A.B. Dick (number 91). Next year's list might also include Pertec, now number 104, as part of Triumph Adler. And Mostek's acquisition by United Technologies (number 19) might boost the latter's position.

Distributor Cramer's revenues (number 99) should become part of Arrow's, and their combined sales might mean another distributor on next year's list besides the distributor part of Avnet, number 32. Wyle just missed the list this year, placing number 108.

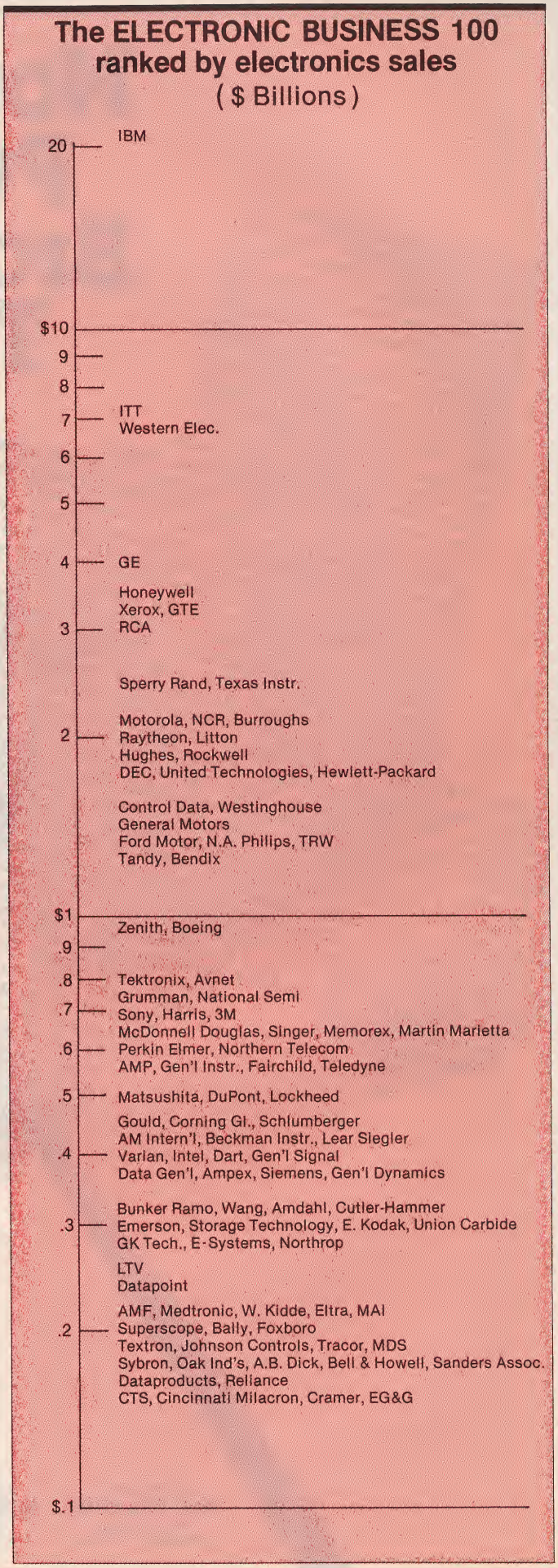
Acquisitions of U.S. companies by Schlumberger and Northern Telecom, among others, bring up the issue of foreign ownership. N.A. Philips, Sony, Matsushita and Siemens are already factors in the U.S. market. Next year's top 100 might also include Triumph Adler, Thorn Electric (which acquired Systron-Donner) and NEC America.

Spurred by the U.S.' relatively stable political and economic environment and the value change in the dollar, foreign concerns are increasing their U.S. investment efforts. Meanwhile, U.S. companies face growing international competition for markets that are no longer solely domestic. "Even Uncle Sam has awakened to this problem," says Wasserman.

But U.S. companies have much to gain from international competition, he adds. Japan and Europe emphasize positioning, product quality and reliability, a happy work force and cooperation among labor, management and government. By contrast, U.S. companies are driven by quarterly statements. "We're younger," says Wasserman, "but we need to look at business from the longer term. We can't adapt totally, but can we get some of that perspective?"

Wasserman sees problems ahead so long as management remains on the same path. "You just don't see management changing hands because the industry is still young," he says. The original managers of the older companies are now in their sixties but are still in control. The times have certainly changed, as this year's top 100 companies illustrate. "But the common response is that times haven't changed that much," laments Wasserman. "I'd say the electronics industry is due for a solid review."—***D. Domenicali.*** Research: ***L. Stallmann***

Reprints of this year's ELECTRONIC BUSINESS *100 will be available in March. One to nine copies cost $2.00 each; 10 to 99 copies, $1.60 each; and 100-499 copies, $1.00 each. For over 500 copies, contact Art Lehmann, Cahners Reprint Service, 5 Wabash Avenue, Chicago, IL 60603, (312) 372-6880. Please address inquiries and payment to* ELECTRONIC BUSINESS *100, 221 Columbus Avenue, Boston, MA 02116. Payment must accompany order.*



Computer interconnection boosts fiber optic market

Fiber optics might have a rosy future in the U.S., especially as data links between computers and terminals, but total user acceptance isn't yet in sight.

To find fiber optic telecommunications already in place you'll have to go to Shanghai; the U.S., like many other more developed regions, currently has its hands tied with prior investments in existing telephone systems. Although today the military and telephone industries are the largest single users of fiber optics in the U.S., the biggest share of the dollar volume in the next five years will likely come from fiber optic interconnection of computers, peripherals and sensors, says Kessler Marketing Intelligence of Newport, R.I.

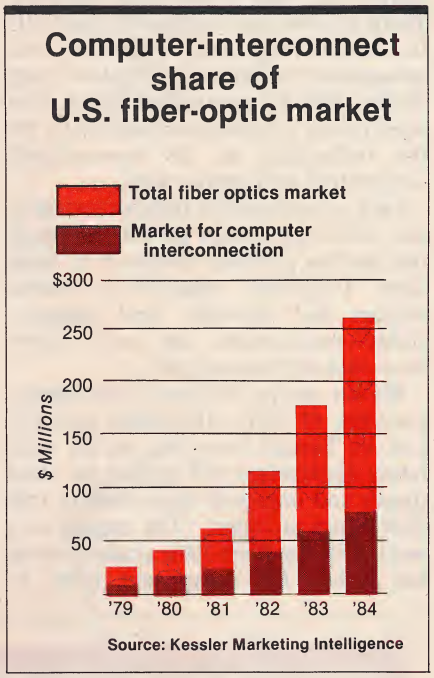
Because computer interconnection typically occurs within a building rather than over long distances as in telephone systems, less cable is used and more of the cost of the system goes into other components—connectors, transceivers, light sources and couplers—than into the cable itself. The price decrease of these components is slower than the decline in cable prices, which accounts for some of the market share that computer interconnection will gain.

Also driving the rapid growth of computer interconnection via fiber optics is a current network base nowhere nearly so extensive as the U.S. telephone system. Therefore, users are more willing to put fiber optics into a system that doesn't replace a prior one.

Hazy beginning, clearer future

Although no one is quite certain when the market's upswing will begin nor how steeply it will rise, most market analysts agree that it should start sometime during this decade. Kessler Marketing Intelligence expects the total U.S. fiber optic market to grow from about $30 million last year to over $250 million in 1984. Out of this total market, computer interconnect applications of fiber optics will reach almost $80 million in 1984 from 1979 sales of $13 million.

Last year military applications accounted for the largest share—$3.6 million—of the U.S. market for fiber optic computer interconnection, with end users (utilities, transportation and chemical industries, financial systems, earth stations and experimenters) purchasing $3.2 million worth of systems, says John Kessler, president of KMI. Over the next five years end users' market share will decline, and the slack will be taken up by OEM markets (computers, process control and office automation), which purchased $2.6 million worth in 1979. In addition, vertically integrated OEMs made $2.3 million worth of fiber optic components for captive consumption.



Kessler says the following factors will drive the market:

- Copper prices are rising and will probably continue to increase while fiber optic cable prices decline.
- Data transfer needs are growing and distances increasing, which will probably require greater bandwidth distance capability and improved error rates, areas in which fiber optics excels over coaxial and other cables.
- Electromagnetic interference and ground loop problems are intensifying and will require more isolation via shielding, separation and quality control. Fiber optic technology is impervious to EMI and ground loop disturbances.
- Increasing needs for secure transmission, now primarily military, will come from commercial and industrial markets. Fiber optic systems could replace more costly encryption equipment.
- As more data equipment is installed, fiber optics' advantages in size,

A fiber-optics glossary

Bandwidth: The complete range of frequencies over which a particular information system can function. Because it varies with length in optical fibers, bandwidth is typically expressed as a frequency-distance (megahertz-kilometer) product.

Coaxial cable: Cable consisting of two conductors, one a central wire and the other a cylinder concentric with the wire, with the space between them filled with a dielectric.

Couplers: Components that interconnect a number of optical waveguides (fibers) and provide an inherently bidirectional system by mixing and splitting all signals within the component.

Electromagnetic interference (EMI): Disturbances caused by electromagnetic waves (radio, heat, light, etc.) that can impair the reception of the desired transmitted signal.

Error rates: A measure of the ratio of the number of characters of a message incorrectly received to the number of characters of the message received.

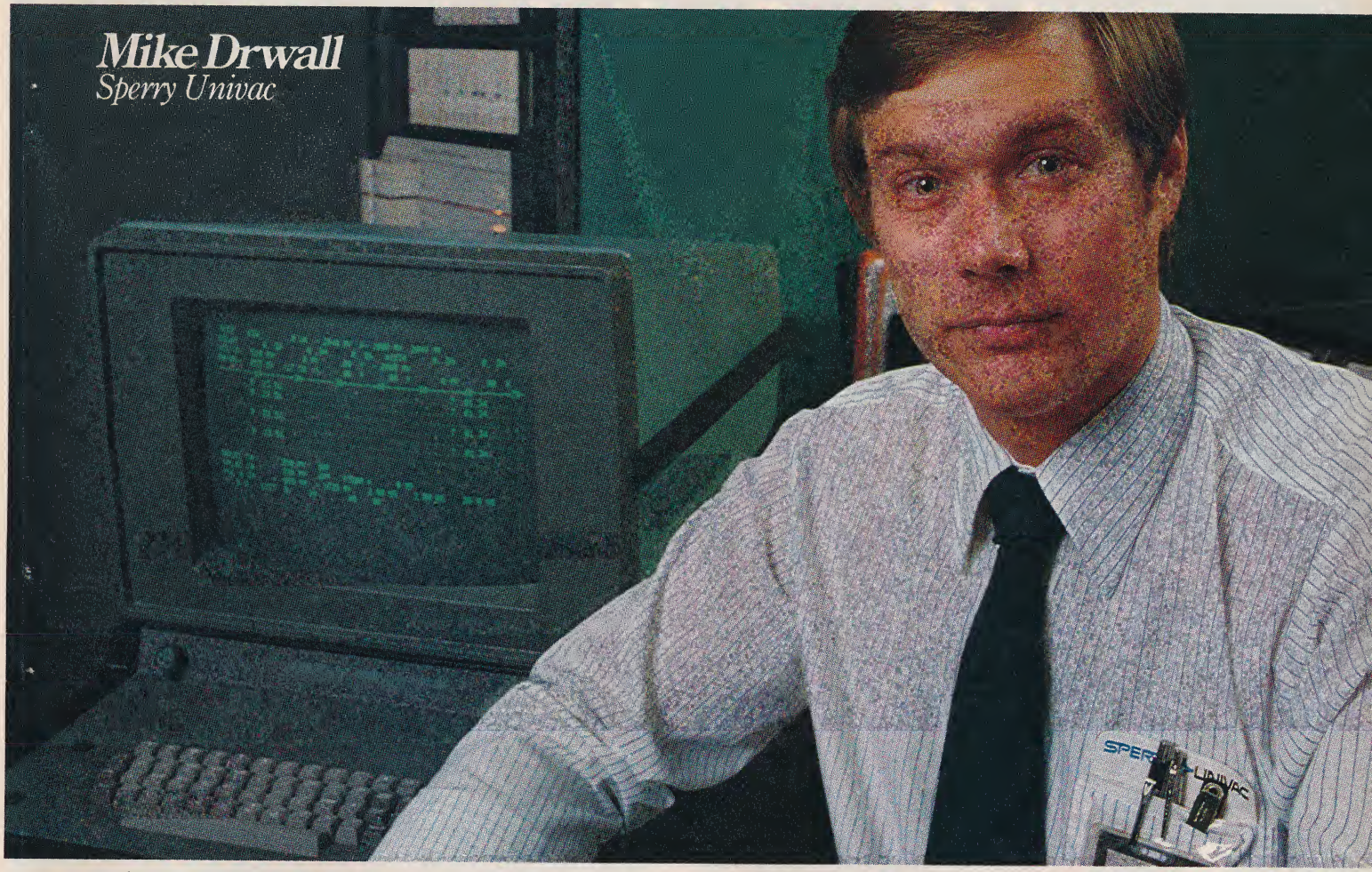
Fiber optics: The technique of conveying information in the form of light signals through a particular configuration of glass or plastic fibers.

Fiber-optic computer interconnection: A means of connecting a computer with a terminal or another computer to transmit electrical signals via fiber optic cable instead of wire.

Ground loop disturbances: Detrimental interference formed when two or more points in an electrical system that are nominally at ground are connected by a conducting path such that either or both are not at the same ground potential.

—T. Ormond, EDN Magazine

"With the kind of performance expected from Univac computers, testing ECL prop delays is just plain necessary."



A lot of ECL goes into every one of Univac's 1100 series computers. Mike Drwall knows that. As Quality Test Engineer for Sperry Univac's Semiconductor Control Facility at Minneapolis, Minnesota, he sees about a million ECL parts every month.

Univac tests every one of them for dc and functional performance on a Teradyne J325. But that's not enough.

"Our ECL parts are among the best devices we buy," Drwall says, "but in a business where speed is the name of the game, we have to test prop delays as well as dc and functional performance."

To handle the ac testing, Univac uses a Teradyne S357 Pulse Parametric Subsystem.

Why the S357?

"Right now, we're testing 10k series ECL, with prop delays of from 1 to 4 nanoseconds. Soon, we'll be getting 100k parts with subnanosecond delays. We chose the S357 because it will handle subnanosecond ECL just as well as it handles today's parts."

Performance is one reason why Sperry Univac chose the S357. Reliability is another.

"We use a lot of Teradyne gear here at SCF, and production test requirements demand high availability, because we work our systems around the clock."

High performance *and* high reliability. If you're testing ECL devices, you need both. You get both in Teradyne's S357 Pulse Parametric Subsystem, designed as a companion to the J325 Digital IC Test System.

For more information on the S357, write Teradyne, Inc., 21255 Califa Street, Woodland Hills, California 91367, or telephone your nearest Teradyne Sales Office.

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Semiconductor test systems are nothing new to Tektronix, we've been building them for years. Today, there's the S-3270 for device characterization, the S-3250 for production testing, and the S-3280, created to test high-speed ECL/LSI devices. Each has a 20 MHz clock rate.

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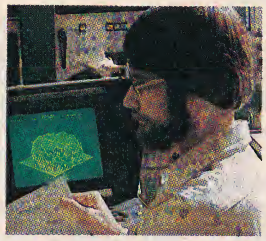

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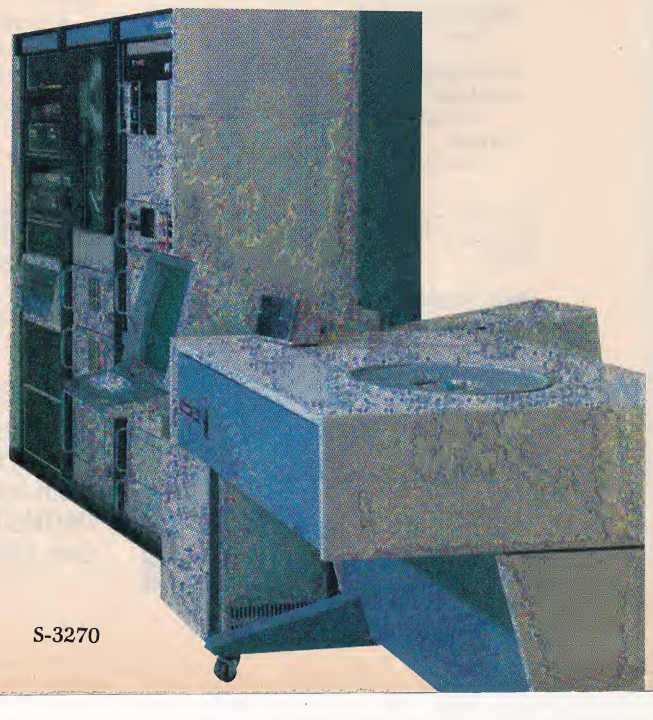
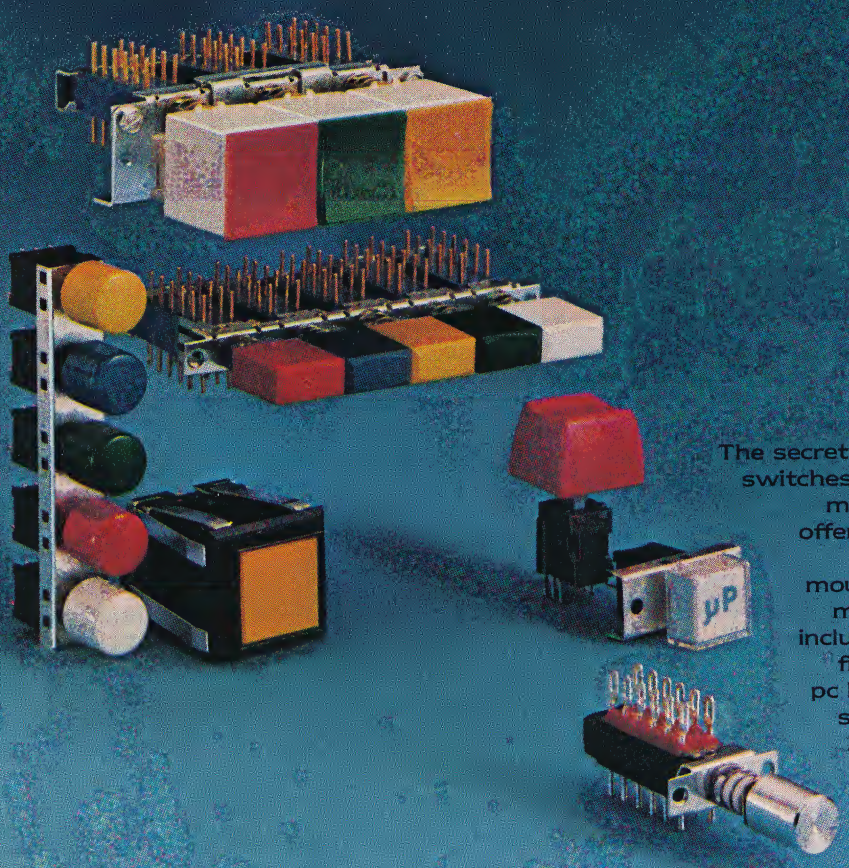


S-3270

The foremost solution to switch design flexibility...

Modular Pushbutton and Key Switches *from* CENTRALAB



The secret to widening your choice of pushbutton switches is the unusual flexibility of Centralab's modular pushbutton switch systems. We offer the versatile PBS Series for horizontal mounting; the MPS Series for vertical mounting. Our long list of options help you meet the most demanding requirements, including microprocessor applications. You'll find lighted and non-lighted switches for pc board or snap-in panel mounting; single station or ganged assemblies with 10 to 25mm spacings; 2-4-6 or 8 pole designs for push-push, push-pull, momentary or interlocking operation with lockout options; silver or gold contacts; epoxy sealed terminals; and a variety of switch housing materials. An outstanding choice of other options includes buttons, colors, lenses, filters and legends.

One feature of Centralab pushbutton switches that's not an option is our outstanding service. A nationwide network of Pushbutton Switch Distributors offers custom assembly and fast delivery of standard switches and options. And there's a Centralab Representative near you, ready to supply application help with your design.

Discover why the foremost source for switches is Centralab. Call your Centralab Distributor, Sales Representative or write Centralab Electronics, Division Globe-Union Inc., 5757 North Green Bay Avenue, P.O. Box 591, Milwaukee, Wisconsin 53201.

government imposes favorable consumer credit and investment policies and import restrictions to fuel the industry's growth, production levels will rise from $258 million in 1977 to $370 million in 1982.

Nevertheless, the domestic industry won't be able to satisfy surging demand, and imports, 44 percent of 1977's $398 million market, will account for nearly 50 percent of 1982's $643 million market.

According to U.S. Commerce Department statistics, U.S. firms captured 34 percent of 1977's $173.5 million import market. Japan ranked a close second with a 27 percent share.

Offering low-priced components, Japan has yet to match the quality of U.S.-made goods, and projections indicate that the U.S. will still lead with 40 percent of a $315 million import market in 1982.

Although U.S. suppliers of passive components will face stiff competition from the heavily protected domestic industry, booming semiconductor demand will help even the odds. Sales of U.S.-manufactured semiconductors will rise 14 percent a year from $65 million in 1976 to $110 million in 1980 as demand intensifies from consumer, telecommunications, business equipment and data processing markets.

Optoelectronics, also gaining momentum, will be a source of significant demand for displays, lamps, couplers and other similar devices.

Telecommunications gets top priority

Over the past few years, Brazil's telecommunications industry has progressed substantially with the help of massive government financial support. Between 1970 and 1978, the number of installed telephones, growing 13 percent a year, hit 4.5 million nationwide. Other telecommunications systems have also flourished, such as telex, long distance and international telephone communications.

According to U.S. Commerce Department projections, even though government funding will be reduced somewhat, Brazil's telecommunications industry will grow 10 percent annually from $2.1 billion in 1977 to $3.2 billion by 1982. Imports, increasing even faster, will grow about 15 percent a year, topping $380 million by 1982.

New government investments in long distance telephone communications, telex services and stored program controlled (SPC) exchanges will generate healthy demand for U.S. equipment: Sales are projected to rise from $54.6 million in 1977 to $112.6 million by 1982. U.S. export opportunities will include telecommunications products not yet manufactured in Brazil—equipment for telephones, telegraphs, radiotelephones and radiotelegraphs, as well as television, radio and broadcasting systems, and mobile radio, microwave and other transmitting and receiving devices.

And sometime in the early 1980s, Brazil will launch its domestic telecommunications satellite project. After completion of the first phase, estimated to cost from $150 million to $200 million, another $300 million will be spent for ground stations and receivers. Offering excellent sales targets for U.S. suppliers, the entire project will consist of three satellites with 12 transponders, one ground control station, three high-capacity ground stations and 150,000 direct receivers.—*R.B. Swartz*

Brazil: Best sales opportunities for U.S. suppliers 1979 to 1982

Electronic components:
Glass, ceramic and variable capacitors
Two-layer printed circuits
Light-emitting diodes (discrete and multidigit)
Bipolar small signal transistors
Radio frequency microwave power transistors
Rectifiers over 3.5 amps
Optoelectronics
Digital bipolar memory integrated circuits
Digital MOS (metal oxide semiconductors)

Electronic production equipment:
Integrated circuit component assembly machines
Chemical vapor deposition systems
Connector assembly machines
Diamond scribers
Electroplating equipment
Encapsulating machines
Semiautomatic and automatic probing systems
Screen printers and processing equipment
Terminal installing machines
Component insertion and removal tools
Connector processing tools
Small parts handling tools
Terminal insertion tools

Test instrumentation:
Coating thickness testers
Diode testers
Integrated circuits testers
In-circuit component testers
Resistance testers
Transistor testers
Waveform analysis instruments

Source: U.S. Department of Commerce/Industry and Trade Administration

Managers

RCA
Kenneth D. Lawson becomes director, facilities management, for the Indianapolis, Ill., RCA Consumer Electronics Div. His functions include managing policies and programs regarding planning and execution for the CED facilities. A 30-year veteran of the company, he was formerly with its corporate staff.

■

Litton Microwave Cooking
Previously director of consumer manufacturing operations in Minneapolis, Michael Dolen has been promoted to director of the Sioux Falls, S.D., plant.

■

Rockwell International Corp.
Rockwell's Electronic Devices Div. has named Arthur B. Branstine VP and general manager of its Anaheim, Calif.-based Interconnect Systems. This newly formed group aligns the former Interconnect Products and Hybrid Microelectronics centers. At its U.S. and offshore plant sites, Interconnect Systems designs and manufactures custom multilayer circuit boards and hybrid microcircuits for systems produced by Rockwell. Also within the Electronic Devices Div., John L. Archer fills the post of VP, bubble memory products, in Anaheim and Newport Beach.

■

United Technologies Corp.
Key operating executives have been appointed for the new Electronics Group, formed to consolidate and direct all of UTC's electronic programs and activities. At UTC's Essex Group, Ft. Wayne, Ind., James A. Connor becomes president. Richard F. Gamble and Edward J. Rapetti become group VPs of the Controls Group, Farmington, Conn., and the Automotive Group, Detroit, respectively. L.P. Sevin remains chairman and chief executive officer of Carrollton, Texas-based Mostek, an independent subsidiary acquired by UTC last fall.

■

AM International, Inc.
AM's Bruning Div. names N. Bruce Walko VP, operations, for Engineering Micrographics Systems at the Dayton, Ohio, and Northbrook, Ill., sites. He has filled various capacities for AM's Addressograph and Infortext divisions. The Bruning Div. manufactures equipment for micrographics and the reproduction of engineering drawings.

Another AM division, Jacquard Systems in Santa Monica, appoints Richard L. Cohen director, manufacturing - engineering, and Charles W. Dorau director, manufacturing. Jacquard manufactures disk-based systems, software and word processing equipment.

■

Persci, Inc.
Former VP of marketing Robert Harlan has been elected to president and chief executive officer of the West Los Angeles-based maker of flexible diskette drives and systems.

■

Intel Corp.
Current director of technology development, Gerhard H. Parker has been named a vice president of the Santa Clara operation. He joined Intel shortly after its inception in 1969.

■

Loral Corp.
Kenneth Years becomes president of Loral's TerraCom Div. in San Diego. TerraCom is the firm's digital communications systems division.

■

Remex
Ex-Cello Corp.'s Remex Div., a computer peripheral manufacturing firm, has promoted William R. Sala to president from VP and general manager of the Irvine, Calif.-based division.

■

Thomson-CSF Components
Ronald Silverstein joins Thomson-CSF Components Corp. as general manager of the Passive Components Div. In Canoga Park, Calif., this subsidiary of Thomson-CSF, Paris, manufactures general-purpose capacitors, ferrites, thermistors and other components.

THERE'S A CLOUD ON THE HORIZON FOR MICROPROCESSORS

Needless trouble with static electricity

It's a fact that many of the components that have made possible the recent boom in the electronics industry are the ones most susceptible to damage from static charge — MOS/FETs, Bi-polar transistors, ECL devices and others.

From fabrication to assembly, to transportation and normal operation of the finished product — the danger of static is always present. It is a randomly occurring problem causing a high rejection rate. And, it is the unrecognized cause of many of the "unexplained malfunctions" experienced by end users.

There's no getting away from it. Static is generated in all sorts of weather, and under all kinds of conditions.

Static control for product reliability, fewer rejections, less degradation, fewer service calls

Traditional quality control programs concentrate on detecting destroyed components. Unfortunately, even products which have undergone complete and rigorous testing can experience premature field failure due to static-degraded components, resulting in expensive in-field service calls and product recalls.

In other words, defect detection can never be as complete, nor in the long run, as economical, as defect prevention.

If you think your company and your customers can benefit from fewer static-related rejects and in-field failures, investigate a system to solve the totality of the static problem. A system based on two simple principles:

1. **Handle all static-sensitive components at a static-safe work area**
   A static-safe area is any area that is capable of controlling static charge on conductive materials, people and nonconductive materials.
2. **Transport all static-sensitive components in static shielding containers or packages**
   A static shield must be capable of protecting from static discharge as well as static fields.

A complete static control program requires a total static control system, and only 3M manufactures such a system.

- Grounding devices for draining the static charge from people and conductive materials
- Ionized air blowers to neutralize the static charge on nonconductive materials
- Static shielding products to protect static sensitive devices during delicate transportation.

In addition, only 3M has the static analysts with the expertise to design a complete static control system to meet all of your specific needs. These are trained specialists who can help keep the clouds out of your exciting future.

For information on contacting the static analysts nearest you, see the listing on the facing page.

TOTAL CONTROL OF THE STATIC IN YOUR BUSINESS

Markets of the '80s

Office of the future to use integrated text/data processing

Datapoint Corp. and other established manufacturers announce products for a market that won't amount to anything before the mid-'80s.

Productivity in the U.S. hasn't set any records recently. But over the last few years manufacturing and farm workers have improved their productivity at double digit rates, while office worker productivity has improved less than five percent. This lag could result from the large discrepancy between per capita investment for factory workers ($24,000 annually) and office workers ($3000 annually) that's existed for the last decade. To catch up, corporations will soon seek to automate as many office functions as possible, thereby creating a multibillion dollar market for office automation equipment.

From these roots emerges the oft-touted but rarely seen "office of the future"—a marketplace for the most advanced word processing, data processing and communications technologies. The key to this future market lies in merging these capabilities into one integrated office system.

According to New York-based market research firm Quantum Sciences Corp., typing/text editing equipment shipments will reach $4 billion by 1984, up from $1.54 billion in 1978. Shared processor systems will account for 25 percent of 1984's shipments, and that's the segment in which the majority of integrated systems will fall. Right now the researchers say the fraction for which integrated systems will account is too small to estimate, but once the market begins to develop to any great extent, sometime in the mid-'80s, it will really take off—eventually accounting for billions of dollars.

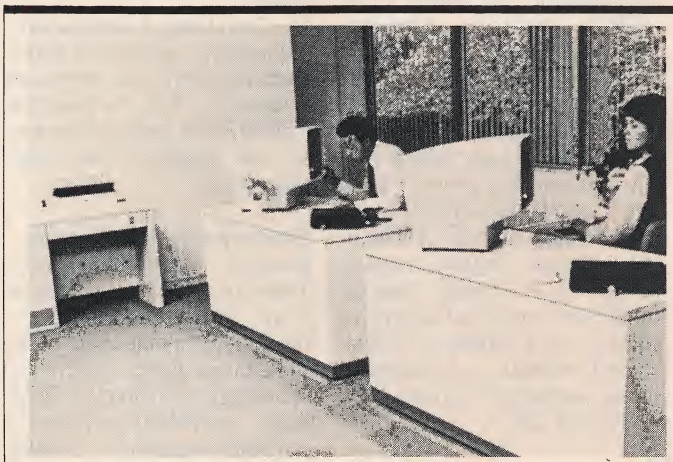
Recently, Datapoint Corp., the San Antonio, Texas-based manufacturer of dispersed (the company's term for distributed) data processing and communications management equipment, announced integrated system capabilities that strengthen its chances for the lion's share of the office-of-the-future market. In so doing, Datapoint competes with the likes of AM Jacquard, Basic Four, Digital Equipment Corp., Exxon, Four Phase Systems, Inc., IBM, Lanier Business Products, Wang Laboratories, Inc., and Xerox Corp. Although all the proposed systems are purported to meet the same needs, all offer slightly different capabilities that vary with the vendor's orientation.

Entries come from two directions

Quantum Sciences' Melody Johnson says equipment manufacturers usually approach the market from one of two directions—the text editing (word processing) side or the small business systems (data processing) side. AM Jacquard, Olivetti, 3M and Xerox have entered with systems based on text editing processors, while Basic Four, Datapoint, Digital, Four Phase and Nixdorf have come in from the small business systems angle.

But attacking the market from both the data processing and word processing sides is Wang Laboratories, which believes it is in an excellent position to take the lead. "We needed a significant market to call our own," says a spokesman. "And the integrated office of the future is that market." However, few market analysts are willing to go along with that opinion, saying the market is too young and competition too intense to peg any one company as the probable leader.

Another major minicomputer maker looking at combining word and data processing, Hewlett-Packard doesn't yet offer integrated systems. But David Crockett, manager of computer planning, says, "Our philosophy is that word processing needs to be combined into data processing—and it needs to be tied



(A)

(B)

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EB-2

in with electronic mail and electronic files." HP already uses electronic mail internally.

Crockett says HP will likely have a small stand-alone system, but he thinks a "partitioned logic" system, with some functions at the terminal and some at a central location, would be more interesting. He won't say when the firm will enter the market, however.

While IBM's General Systems Div. (GSD) has introduced a text editing system, the 5520, that could deliver data processing at some future time, the giant computer manufacturer's initial entry comes from the mainframe side (the Data Processing Div.) with its 3730 distributed office communications system that offers both text and data processing either as a stand-alone system or attached to a host 370.

But of all entries, says Quantum Sciences' Johnson, Datapoint's recent aggressive thrust appears to put it in a good position to capitalize on this promising embryonic market.

Based on its attached resource computer (ARC), Datapoint's integrated electronic office products allow customers to add word processing and electronic message switching capabilities to installed Datapoint systems at minimal additional cost, according to the company. The word processing function is a software package users can add for $750 plus the cost of whatever medium is used to put it on the system. (The $750 includes the software license and tuition for one week of user training.) Electronic message services cost a bit more because they require additional hardware (an ARC processor) to handle message-traffic management.

Datapoint hopes its current and prospective customers will recognize the low cost flexibility it says its systems offer. "The two principle product areas in which we've been operating, dispersed data processing and communications management, are completely integrated using common products and operating against a common data base through the ARC system," says Harold E. O'Kelley, Datapoint's president, chief executive officer and board chairman. "Word processing and electronic message services are also integrated in the sense that both are basically software additions to existing products."

O'Kelley points out that current users must have large-screen display terminals (models 3800, 1800 and 1500) to incorporate word processing and that electronic message services do require an additional business processor that operates as the message controller.

"New customers will have to buy hardware as well as software," O'Kelley says, "but all customers will be able to operate in a data or word processing mode or use their product as the terminal for electronic message services just by calling for the appropriate programs."

As O'Kelley sees it, both new and old customers gain from Datapoint's new marketing strategy. "Any existing product can operate as a message station," he says. "That means that none of our current products becomes obsolete; in fact, they're enhanced. And new customers will have greater flexibility."

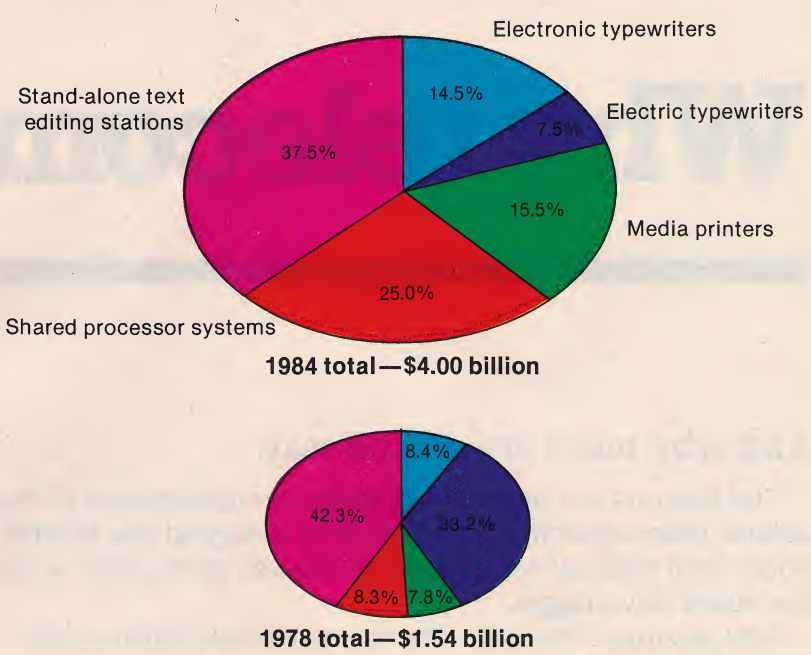
Economies of scale

Basing its integrated office primarily on software doesn't leave all the benefits to Datapoint's users; the manufacturer also reaps some rewards. Right off the bat, Datapoint comes out ahead in terms of economies of scale—it makes the same product no matter what its intended application. So with the increases in sales from the new offering, Datapoint will save on manufacturing costs by spreading them over a greater number of units.

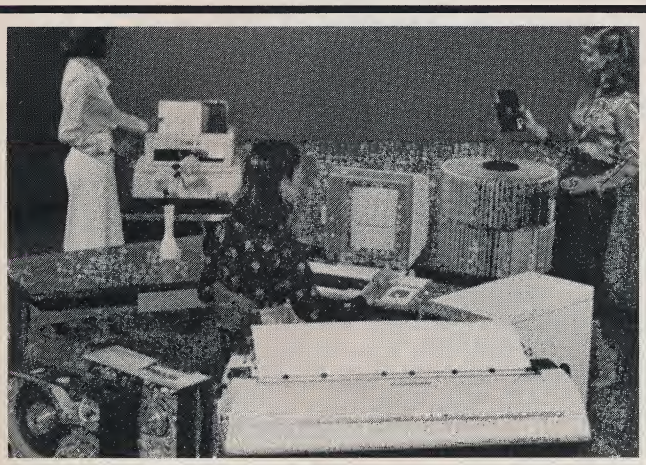
"We also get more bang for our

Continued on page 65

Typing/text editing equipment shipments



Source: Quantum Science Corp.



(C)

Integrated office systems

Designed for the "office of the future," these systems represent the latest advances toward a promising but enigmatic market. IBM's 3730 (A), which debuted almost two years ago, offers mainframe users the capability of both word and data processing on the same machine. Datapoint's integrated electronic office (B) puts the firm in the competitive mainstream. Xerox' 860 (C) permits virtually unlimited growth and uses the latest Winchester technology 8-inch disk drives from its Shugart subsidiary. ■

Brazilian imports of U.S. components, production equipment and test instrumentation will grow from $62 million in 1977 to $132 million by 1982.

peripheral imports by Brazil rises dramatically. Benefiting from the growing Brazilian minicomputer industry's peripherals requirements, this market will hit $26 million by 1982, with the U.S. copping a 35 percent share.

Good sales prospects for U.S. exporters in this arena include diskettes, fixed and removable disks, conventional and cassette/cartridge tape drives, as well as peripheral controllers and interfaces, auxiliary memories, mass storage systems and acoustic couplers.

Production and test markets take off

The Brazilian government's intensified efforts to develop a strong national electronics industry will spark demand for production and test equipment, aided by a trend toward automation and technological advances by both end-user product manufacturers and the electronic components industry.

Despite some headway in the manufacture of simple printed circuit boards, molding presses, numbering and plastic forming machines, and soldering equipment, Brazil still produces a limited range of low-quality equipment that lags U.S. standards by 10 years. And of the 62 local firms that make special equipment and materials for the components industry, only a few supply tools and test instrumentation.

Nevertheless, domestic test and production equipment output, spurred by a growing components industry, will rise from $2.7 million in 1977 to $6.6 million by 1982. However, the market will still rely heavily on foreign sources.

According to the U.S. Commerce Department, Brazilian imports of test and production equipment valued at $8.7 million in 1977 will reach $16 million by 1982, with the U.S. share almost doubling from $3.1 million to $6 million.

Of the two markets, production equipment will take the lead: Swelling 16 percent a year, it will top $18 million by 1982. And although Brazilian output will nearly triple between 1977 and 1982 from $2.3 million to $6 million, imports will still surge from $6.5 million to $12.3 million and U.S. sales will more than double from $2.0 million to $4.1 million.

In the test instrumentation arena, U.S. manufacturers will benefit from the increasing sophistication and complexity of Brazilian-produced electronic devices. Imports, 85 percent of 1977's $2.6 million market, will grow almost 12 percent a year, reaching $3.8 million by 1982. U.S. firms, which supplied half of 1977's imports, will continue to dominate the market despite tough West German competition.

Brazilian buyers, faced with sharply increased printed circuit demand from the consumer electronics sector, will turn primarily to U.S. suppliers for high-quality PC production equipment, creating good export opportunities for assembly, diamond scribe wafer dicing, and encapsulating and electroplating equipment.

Other kinds of production equipment ripe for Brazilian markets include screen printers and processing equipment, connector processing and terminal insertion tools, semiautomatic and automatic probing systems and integrated circuit component assembly machines.

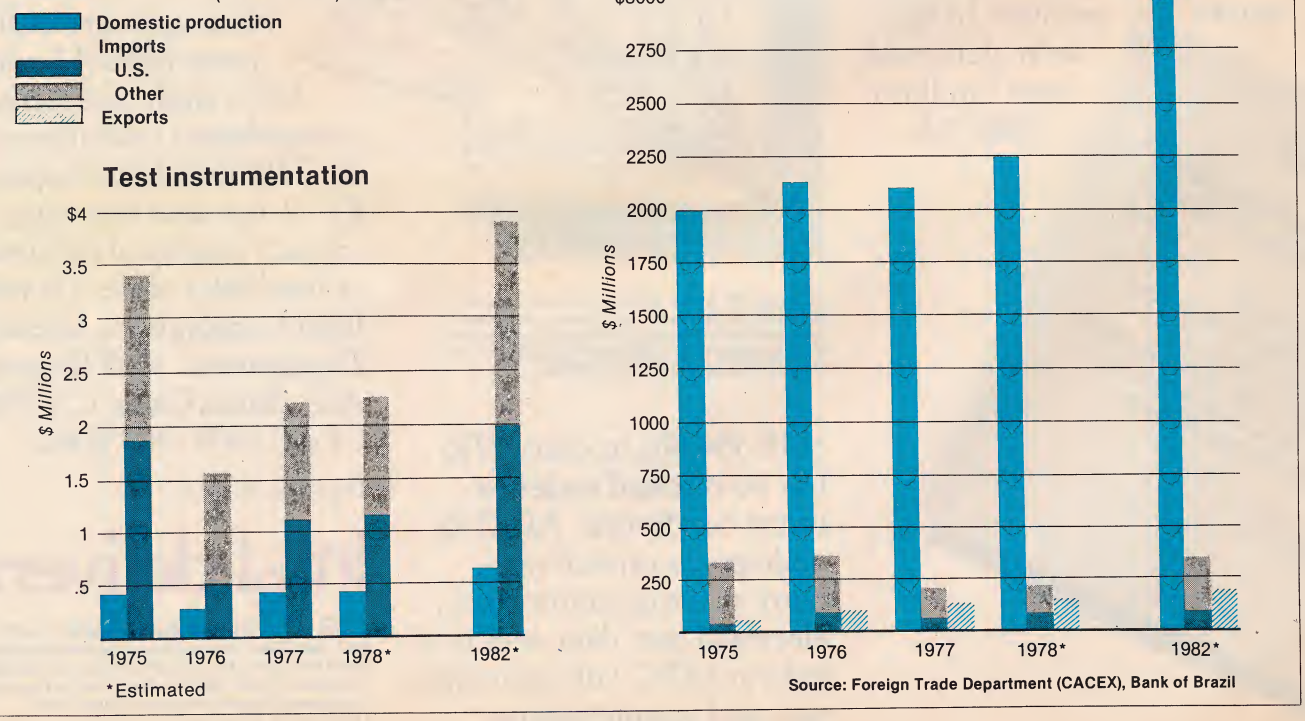
As Brazil's electronic production becomes more sophisticated, U.S. suppliers can expect heavy demand for testers of coating thickness, diodes, integrated circuits, in-circuit components, resistance and transistors, as well as signal source and waveform analysis instruments.

Component imports to climb

Brazilian government programs to develop consumer, computer and telecommunications sectors will generate strong demand for U.S.-manufactured components, especially more advanced types. Sales to nonelectronics markets using more electronic controls, like machine tools, will also rise.

Most of the 81 firms producing electronic components in Brazil make traditional, if not old-fashioned, devices for consumer goods. But as Brazil's

The Brazilian electronics market (continued)



Why telecom majors

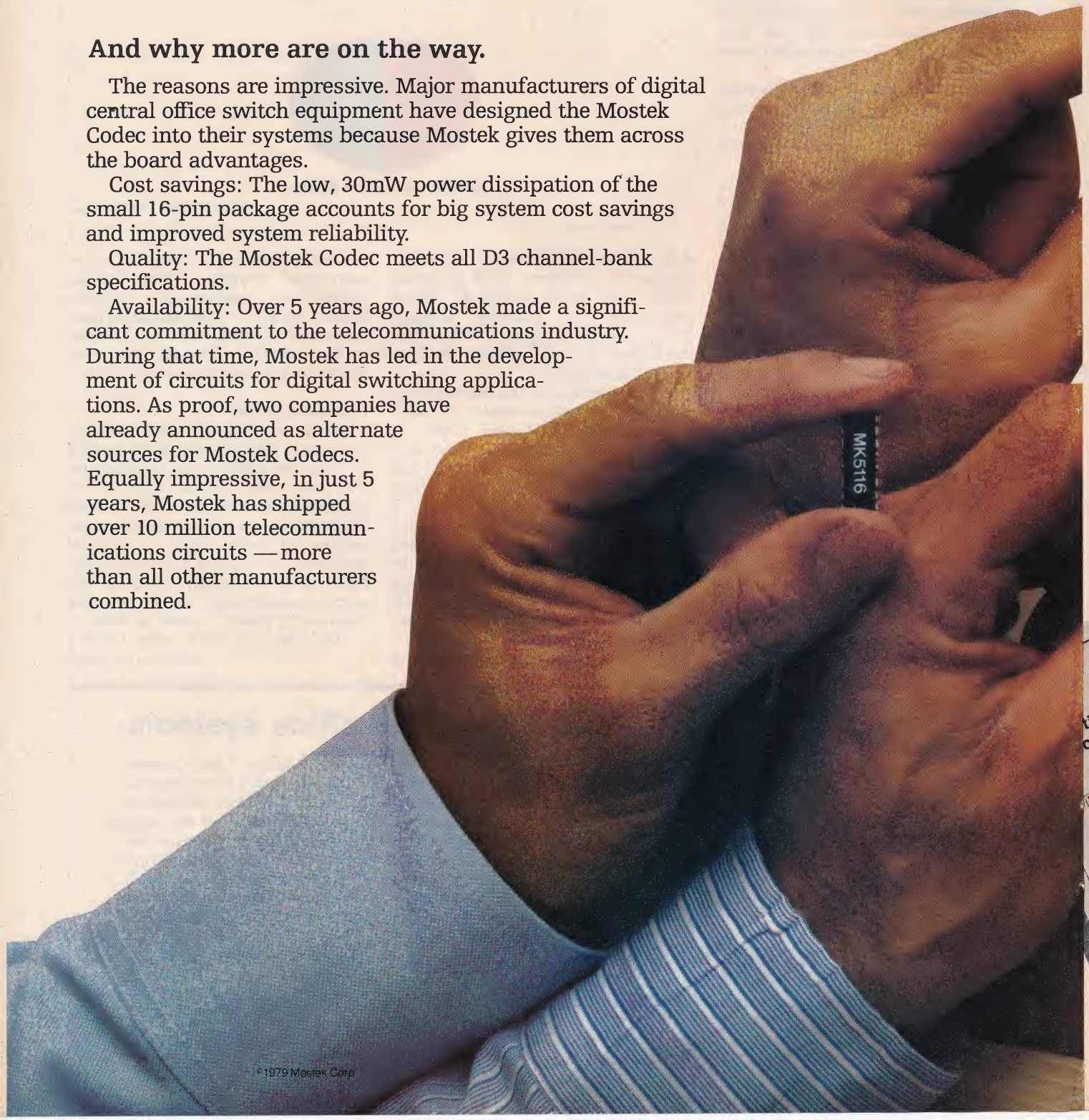
And why more are on the way.

The reasons are impressive. Major manufacturers of digital central office switch equipment have designed the Mostek Codec into their systems because Mostek gives them across the board advantages.

Cost savings: The low, 30mW power dissipation of the small 16-pin package accounts for big system cost savings and improved system reliability.

Quality: The Mostek Codec meets all D3 channel-bank specifications.

Availability: Over 5 years ago, Mostek made a significant commitment to the telecommunications industry. During that time, Mostek has led in the development of circuits for digital switching applications. As proof, two companies have already announced as alternate sources for Mostek Codecs. Equally impressive, in just 5 years, Mostek has shipped over 10 million telecommunications circuits — more than all other manufacturers combined.



Recipe for Reliability

Your system is only as reliable as its EPROMs. That's why Intel delivers every 2716 with an Arrhenius Forecast.

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How EPROMs protect your "value added."

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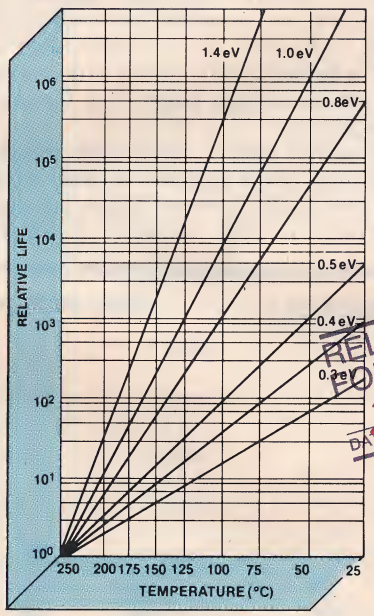
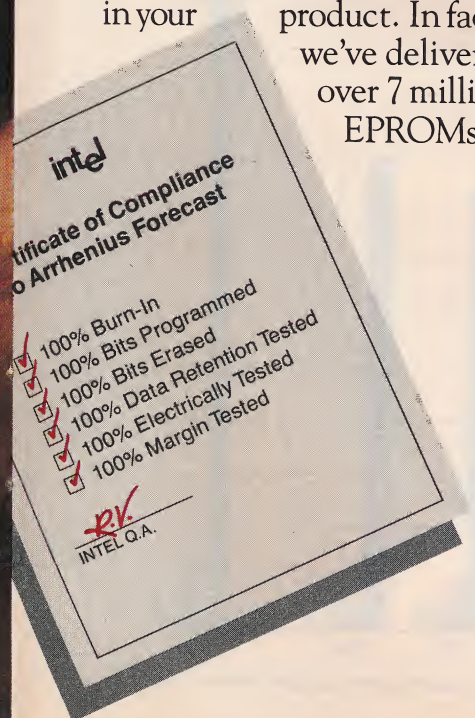
How we make them reliable.

The Arrhenius Forecast you receive with Intel® EPROMs certifies that each of 16,384 bits in every 2716 has been tested under extreme conditions. All 2716s undergo six critical tests: burn-in, programming test, electrical test, data retention bake at 150°C, voltage margin test, and erasure testing.



Arrhenius Plot, above, projects component longevity at different temperatures. By increasing temperatures, Intel simulates extended EPROM operation to predict life expectancy. Such a Reliability Forecast is included in every shipment of Intel 2716 EPROMs.



Our Arrhenius Forecast also gives you confidence that you can count on Intel's 2716s for years to come. Our 5 million hours of accelerated life tests prove it. By simulating extended EPROM operation in your system and using Arrhenius extrapolation techniques, we're able to forecast reliable bit storage of today's 2716s until at least the year 2002 A.D.* It's one more example of the steps we take to build safety into your EPROM purchase.

Send for our recipe.

Because your whole system depends on its EPROMs, it pays to insist on an Arrhenius Forecast with every shipment of 2716s. For a complete summary of Intel's latest EPROM reliability study and Arrhenius extrapolation techniques, get our 2716 Reliability Report, RR19. For your free copy, contact your local distributor or Intel sales office. Or write Intel Corporation, Literature Department, 3065 Bowers Ave., Santa Clara, CA 95051. Or call (408) 987-8080.

*Statistical calculation

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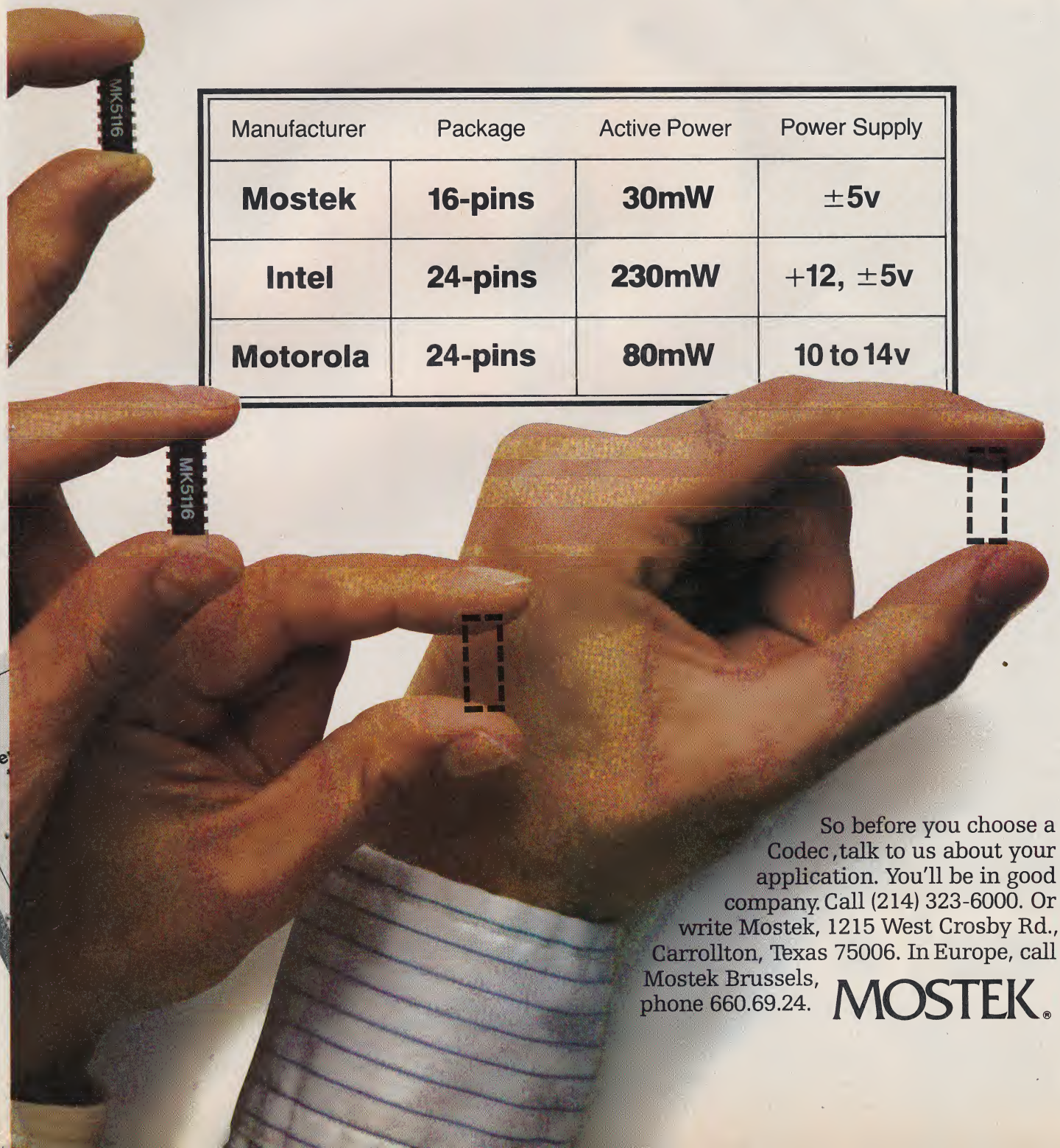
Intel	**24-pins**	**230mW**	**+12, ±5v**
Motorola	**24-pins**	**80mW**	**10 to 14v**



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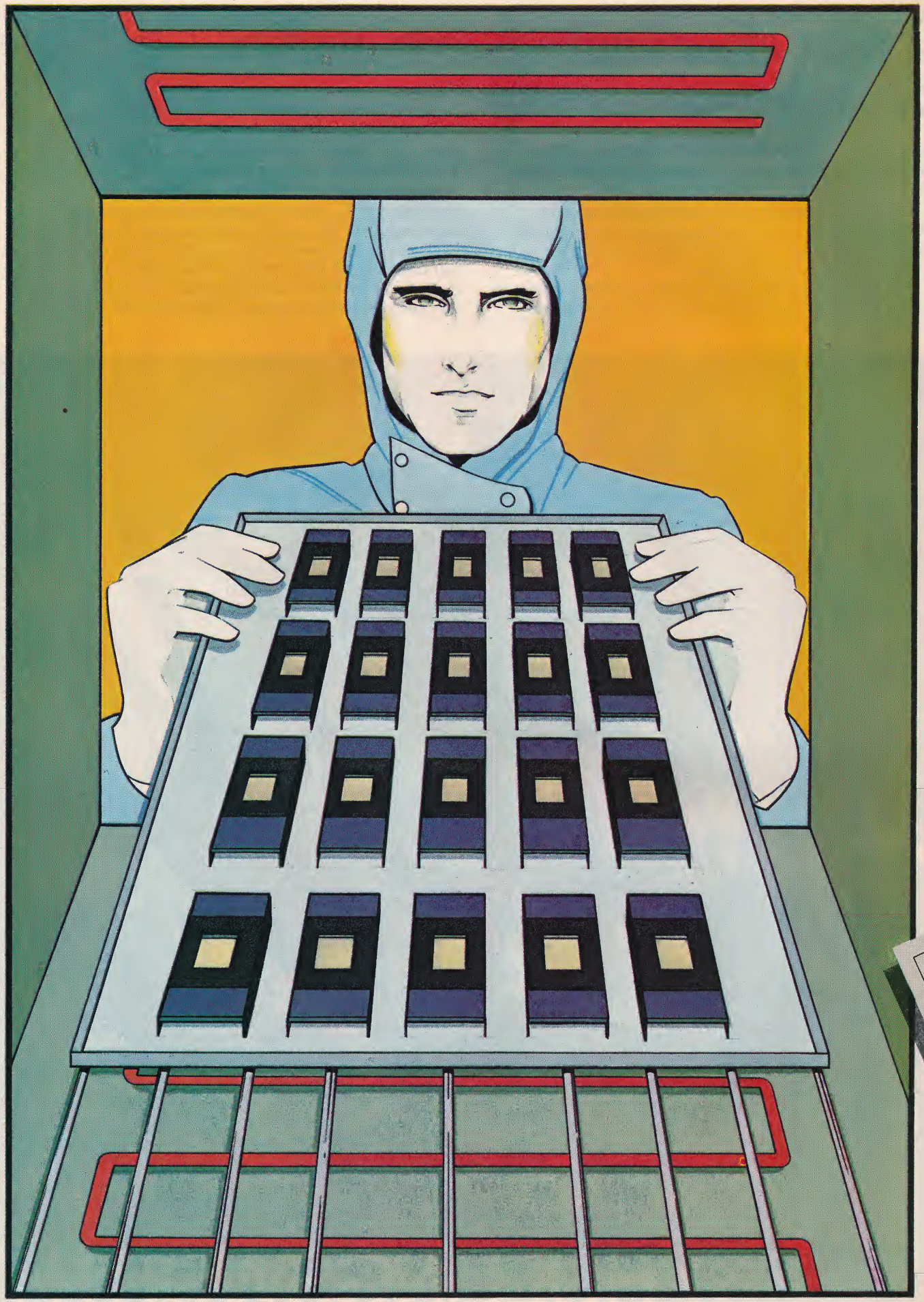


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"It starts with Photocircuits."

J. W. Jaroszewski, Plant Manager, Dynascan Corporation

"The most frustrating moment in the life of anyone in electronics is when he realizes that the trouble he is chasing may be in the test equipment he's using, instead of the equipment he's testing.

"At Dynascan we lean over backwards to make sure that moment never comes."

"Photocircuits plays a continuing part..."

"Our test equipment line ranges from transistor testers, digital multimeters, and power supplies to signal generators and trace analyzers. Our goal in manufacturing is to make them all an order of magnitude more reliable than anything they test. This reliability must begin with our vendors. Photocircuits plays a continuing part.

"Several years ago we traced a number of potential reliability problems back to the soldering line where we had up to 20 different boards running at a time. These boards were used in critical applications."

"As additive came in, touchup went down."

"Because we had heard that additive boards enhanced solderability, we turned to Photocircuits.

"Over the next three years we worked many Photocircuits additive boards into our product line. As they came in, touchup went down and reliability up.

"Today, no matter how we optimize our flow solder process, we know that the additive boards will properly solder with a high degree of tolerance to any process changes.

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Electronic markets

Brazil's electronics industry is ripe for penetration

A fast-growth economic policy opens doors for U.S. suppliers.

Faced with a 50 percent inflation rate and an increasing balance of payment deficit, Brazil is looking to faster industry growth as the cure for its economic ills. This strategy—more exports, more imports—means increasingly lenient trade policies, a phrasing out of onerous nontariff trade barriers and lucrative market opportunities for U.S. suppliers.

As Brazil's economy takes on increased size and complexity, it will require sophisticated technology not yet domestically available. And U.S. manufacturers, considered technological leaders by Brazilian buyers, stand to make considerable gains in computer and peripheral, production and test equipment, component and telecommunications markets.

According to a U.S. Commerce Department survey of export opportunities, Brazil's electronics industry will grow 10 percent a year in real dollars, hitting about $1.8 billion by 1982. Its capital equipment requirements, rising at the same rate, will surpass $650 million by 1981. And capital equipment imports, increasing 13 percent annually, will reach about $330 million by 1982.

Brazilian imports of U.S. components, production equipment and test instrumentation will grow even faster, increasing 16 percent a year from $62 million in 1977 to $132 million by 1982.

Computers come on strong

According to U.S. Commerce Department statistics cited in a McGraw-Hill study of international electronics opportunities, computers and peripherals are up and coming Brazilian markets. Recognizing a shortage of data processing equipment, the government has earmarked this industry for rapid growth through increased imports and larger local production facilities, creating significant trade and investment opportunities for U.S. firms that can supply advanced technology, components and finished products.

Although U.S. suppliers will be shut out of Brazil's minicomputer market per government plans that call for local production to satisfy demand by 1982, small, medium-sized and large computers still offer healthy export potential.

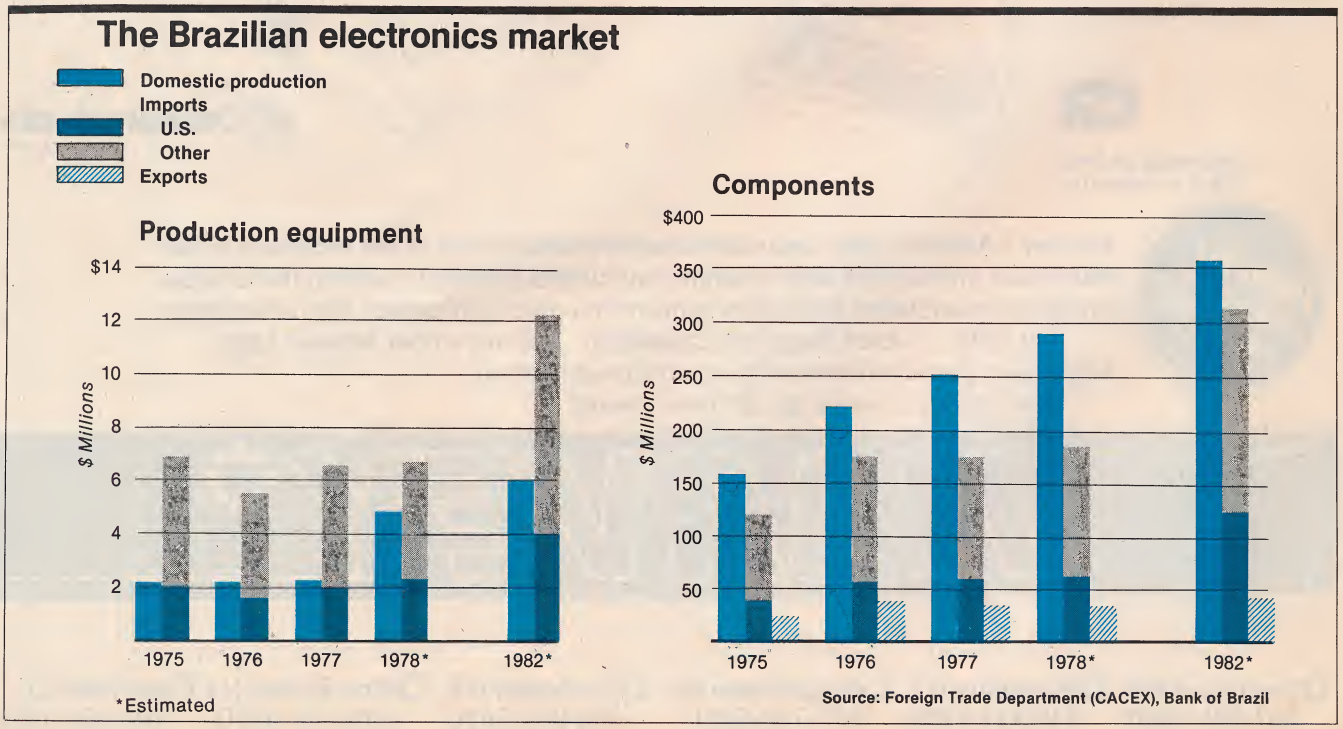
By 1982, the value of Brazil's small, medium and large computer (SMLC) market will hit $93.5 million, with each sector achieving respective annual growth rates of 10, 5 and 17 percent. And U.S. firms, credited with 93 percent of Brazil's SMLC installations by 1977, will continue to dominate this market through 1982.

Another U.S.-dominated market, output devices, also looks promising. The printer segment, estimated at $128 million in 1977, will grow over 27 percent a year through 1982, with heavy demand expected for line, serial and higher speed printers.

Other output products not currently manufactured in Brazil nor planned for domestic production include high speed digital plotters, nonimpact printers and computer output microfilm, as well as point of sale terminals, remote-control automatic cash-dispensing terminals and ticketing and factory data-collection systems.

U.S. computer peripheral exports to Brazil, although losing market share to Third World suppliers and local producers, will nevertheless prove lucrative as the value of separately sold

Continued on page 96



research and development buck," O'Kelley says, "because we're not developing additional hardware products to support separate functions."

Datapoint also shares a service advantage with its same-processor-for-several-functions tactic because fixing the hardware doesn't require knowledge of the system's software: Whether the product is used for data or word processing, as a message center or all three, its architecture remains the same. "There's no additional training; the hardware people don't have to learn the software," says O'Kelley. "The system support people will have to learn it, but maintaining the hardware won't require a concern with the product's use."

However, Quantum's Johnson says Datapoint might run into some problems supporting its new office products users. "I think O'Kelley is absolutely right in terms of maintaining the hardware, but supporting office workers is very different from supporting data processing personnel," she says. A systems engineer can go in and train a programmer to use the system, and in a short time he'll be off and running, she explains, but an office worker, who doesn't have as strong a technical grasp of the computer, requires "a lot more hand-holding."

But if Datapoint takes it slow and carefully builds up its support staff, Johnson believes the company will shine in the integrated office system marketplace. "The company's broad geographic base will give it a foothold in a number of markets, and if it develops the support staff to match, it will do very well."

Because Datapoint will be able to take advantage of economies of scale, O'Kelley says "it boils down to" the customer getting a "great deal of flexibility at a reasonable price."

Young market is a tough sell

With the office market just beginning to take shape, it hasn't been easy for integrated systems vendors to sell their wares, according to industry sources. But O'Kelley and his management team at Datapoint believe their current selling method will accommodate the new systems. "Our product line includes communications management, data and word processing, and electronic message services," says O'Kelley. "And we currently have two focal points for selling—the data processing manager and the communications manager.

"Word processing, which is software, can be sold in either direction," O'Kelley continues. "Generally speaking, I don't think most corporations have a high level manager concerned with office functions. I think that's going to change, but in American industry today there really isn't a data-processing-manager equivalent concerned with office functions—at least not of the same stature and power.

"Our approach provides communications and data processing managers with the tools to improve their companies' efficiency," O'Kelley adds. "And we think that over time those tools will become widespread."

O'Kelley holds that data processing and communications managers will be able to understand and adapt Datapoint's products to their companies' needs. He doesn't expect acceptance to come overnight; rather, he thinks there'll be an evolutionary process within offices that will result in a recognition of the merged system's value.

This view is shared by most, if not all, vendors currently aiming at the market. And if they don't shout about it, it's nevertheless evident from their product offering and delivery timings.

***Datapoint's O'Kelley** admits that U.S. industry hasn't accepted integrated office systems, but he says attitudes are changing.*

Office evolution paces debuts

IBM's General Systems Div. entry, the 5520 administrative system, will offer users word processing when it's first delivered this quarter and add electronic document distribution during the fourth quarter, in accordance with how IBM sees users' needs developing. The company won't say what needs users might develop after that, but given the outlook of the rest of the industry, data processing is a likely candidate, and IBM's 5520 in all probability will be GSD's nominee for the office of the future's data processing/text editing/electronic document distribution requirements. By the end of 1980, it will have two of the three functions.

"We built the 5520 administrative system from the ground up with new architecture specifically for office applications," says Scott Ellington, manager for product sales programs-office systems at IBM's Atlanta GSD facility. "Word processing will be its first application because there's a big need for that today. Then we'll deliver document distribution as a second step."

Ellington says IBM plans release priorities to bring users the functions they need when they need them. Of course IBM also determines the timing. While other vendors rush to announce

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TRW Datacom acts as an independent overseas marketing department—but pays cash instead of requiring it.

ment from Computer Entry Systems Corp., Silver Spring, Md.;

- stand-alone word processing equipment from Boulder, Colo.-based NBI, Inc.; and
- banking, financial and retail transaction terminal systems from TRW Communications Systems and Services.

In some cases, these products are combined with Datapoint computers to form systems.

The ownership key

The TRW Datacom operation in the U.S. is strictly a marketing and management group that works with distributors overseas. The majority of the distributors are independent, but TRW has substantial interest in those in the largest markets. It owns those in Canada, Brazil, Austria, West Germany and Switzerland and has joint ventures in Australia, France, Spain and the United Kingdom.

This ownership is significant to TRW. "A basic part of our strategy is to take an equity position in each company," says Kelly. Matthew M. Shapiro. TRW Datacom director of planning and development, adds, "We operate on a relatively small margin on our pass-through business, so we like the ability to participate in the end-user marketplace where we enjoy higher margins."

The firm has a major European support group in London offering hardware and software training and technical support to its distributors.

Kelly says, however, that a key to Datacom's success is looking like a local company: "We look French in France," he claims. "All the distributors are run by locals."

One aspect of local distribution is field service, a major problem for all types of computer equipment, and TRW devotes substantial effort to it. The company has a worldwide network of almost 3000 servicemen (many in the U.S.).

The firm has approached service, here and overseas, as it has marketing. It doesn't offer third-party servicing but takes over the complete service effort of companies, including ADDS, Pitney-Bowes and Wintek.

Seeking other product lines

With its success so far, it's not surprising that Datacom is looking at additional product lines to distribute overseas. It has an interesting shopping list but chooses suppliers carefully. "The company should be large enough to be financially strong; in general, we're not buying these companies or investing heavily," notes Shapiro.

He says TRW is most interested in companies that are growing rapidly in the U.S. market, which forces management to put its time into organizing a U.S. sales force and expanding manufacturing operations, thus limiting its experience internationally.

Shapiro adds, "We try to pick a company to which the TRW name adds something, as it does for NBI now and did for Datapoint when it started."

The firm is currently seeking to distribute voice telecommunications, optical character recognition and facsimile products, business computer systems both larger and smaller than the Datapoint line, data and voice concentrators and multiplex systems.

Shapiro says TRW is also interested in taking over complete overseas marketing networks whose present performance isn't satisfactory.

The company discussed such a move with Varian Data Machines, Varian's former minicomputer operation. "Varian minicomputers were sold overseas by Varian's sales organization, but the arrangement wasn't very satisfactory. Varian had a broad network, but it wasn't used to selling computer products."

The deal fell through when Varian sold the operation to Univac, eliminating this problem (ELECTRONIC BUSINESS, December 1979, page 94).

Even though TRW is looking to acquire additional lines, it isn't all that anxious to do so. Kelly points out, "It takes a massive effort to bring new products out. We're focusing on those that have the volume to justify bringing them into our business." He adds, "The limitation is our ability to manage them and do well."

And at least in one case, TRW's supplier isn't very happy about the results so far. Thomas S. Kavanagh, president of word processing system maker NBI, Inc., says, "We've been a little disappointed in the slowness with which they've moved. Our independent distributors in France and Australia have made more progress in the same time."

Kavanagh attributes part of this delay to the NBI systems' replacing an earlier line of word processing equipment made by Lexitron and sold by TRW. When Lexitron was sold to Raytheon, which has its own strong organization in Europe, TRW and its distributors lost the line.

The NBI president admits that TRW improves NBI's cash position, and he hasn't lost faith. "Our opinion of the people is unchanged: We think they're superb. With experience, we think the distributors will see that both the word processing industry and NBI are for real."

Kavanagh undoubtedly hopes his company will emulate Datapoint's success. If that happens, though, he'll face the same problem Datapoint does: Should it set up its own distribution overseas?

Kelly acknowledges that possibility, one reason the equity position in its distributors looks so important to TRW.

Datapoint's O'Kelley says he expects some changes in the current arrangement when it runs out in July 1983, but he adds, "We will continue to have a relationship, even if only through those distributors TRW has ownership in."

Why not acquire?

Considering TRW's success with Datacom, it's surprising that no one else has set up a similar organization. "It's also a puzzle why we haven't found another Datapoint," admits Shapiro. "We suspect it's because most companies small enough to fit into our plans have a good chance of being acquired, as happened with Lexitron."

That brings up the question, "Why not acquire the firms whose products Datacom sells?"

Especially Datapoint. Apparently TRW had the opportunity to buy Datapoint in the early '60s. Shapiro admits that many at TRW supported the idea, but the corporation was under financial pressures elsewhere and wanted an assurance it would pay back in three years. "No one wanted to put his job on the line," says Shapiro.

Now, he adds, "a lot of people think with hindsight that we should have bought Datapoint."

Nevertheless, Datacom professes no interest in acquiring its suppliers. "We're not in a venture capital type of business where we acquire as a matter of course," says Kelly.—*P. Franson*

IBM will deliver integrated systems when it perceives an established need for them.

integrated capabilities for a market that has yet to develop to any great extent, IBM will wait until there's a solidly demonstrated requirement.

"Beyond document distribution, office automation offers a tremendous opportunity," says Ellington. "Small offices and remote offices of large companies don't really need two large computers—one for word processing and one for data processing; what they need is a combined system." He stopped short of saying the 5520 would be such a system.

But for large companies, IBM is already meeting the need for integrated capabilities: Its Data Processing Div. offers users the 3730 distributed office communications system that concurrently handles both text and data processing applications either alone or attached to a host 370.

Ellington points out that the three IBM divisions offering office systems market them according to three different philosophies: Office Products offers stand-alone systems; General Systems, shared logic; and Data Processing, the traditional hierarchical approach.

With products based on both word processing and data processing computers, Wang's Integrated Information Systems suit offices that carry out predominantly one function or the other, says a corporate spokesman. "We offer the user either systems based on our virtual storage (VS) general purpose computer with added word processing software, or office information systems (OIS), which are primarily word processors with added data processing software," he says.

But Wang has yet to deliver its software despite an early entry in the market. At a recent meeting of the International Conference of Wang Users, one VS system owner who ordered word processing software in January 1979 demanded to know when Wang would deliver it. Charles L. Farrell, the company's director of market planning and development for large business and integrated information systems, could not say definitely when the software would be delivered, but he assured users they would get it as soon as it passed final quality control checks.

Xerox matches IBM's timing

Entering the market from the word processing side, Xerox Corp.'s integrated system delivery schedule closely matches that of IBM's 5520. Although Xerox will offer business processing applications packages with its first integrated system deliveries slated for this quarter, like IBM it will not deliver its communications capabilities (the long-awaited Ethernet) until the fourth quarter.

Graduated delivery schedules from the major integrated system vendors illustrate the market's developing needs. "Today less than 20 percent of the information generated in offices is maintained on computer," says Donald J. Massaro, president of Xerox' Dallas-based Office Products Div. "And information transfer can take two days. Office automation systems must reduce the hardware involved as well as improve information mangement." Like O'Kelley at Datapoint, Massaro says acceptance will be gradual and automated systems must allow customers an "evolutionary" move into office automation.

Xerox' 860 information processing system "is programmed to handle a variety of text editing applications and the processing of office business records and data," the company says. Designed as a stand-alone system, any number of 860s can be "strung together" to provide multiple functions, according to Massaro. Through Ethernet, a basic 860 workstation can access any part of any other system (it needn't be Xerox equipment) on the network at any other location—within the same office, building or corporation (at different sites via common carrier now and on XTEN, Xerox' data communications network, later).

The 860's communications ability allows users to set up a virtually unlimited system because any part of the system can communicate with any other part. Ethernet provides the link for 860 systems to share resources and logic. (In fact, there's no single host or logic.) Control is also distributed, which localizes any problems that might occur in the system and simplifies service: Should one link fail, the entire system won't, says James S. Campbell, president of Xerox Business Systems in El Segundo, Calif., which developed Ethernet.

Systems remain compatible

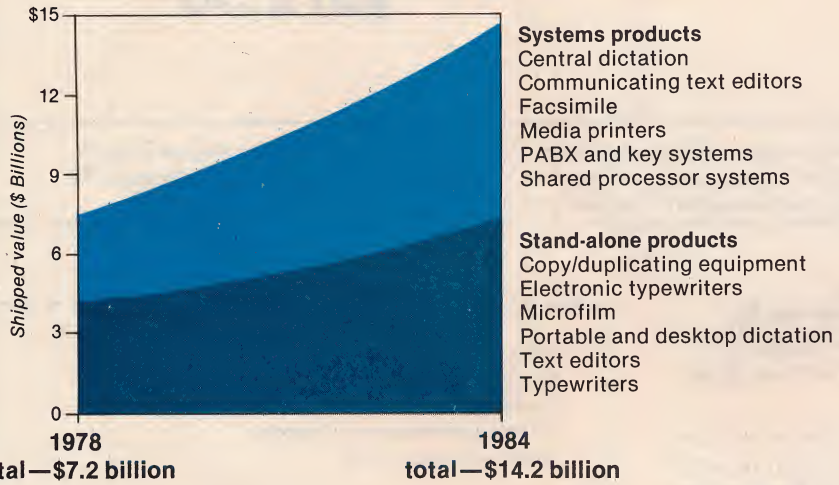
Like Datapoint, Xerox has maintained compatibility with its existing systems. Users of Xerox' 850 page-display typing system can get the 860's "extended" capability by trading system controller units, the company says. Although the basic workstation costs in excess of $15,000, Massaro says pricing will vary for each customer depending on the number of units and the mix of 850s and 860s purchased. He expects overall cost to be significantly less than the $15,000 list price. Massaro adds that the 860 will be the high end of the product line and future announcements will be of lower cost workstations.

Although Xerox' Ethernet will allow an unlimited number of systems to be interconnected, Datapoint's ARC system is limited to 255 processors (used as a Datashare business system, each ARC processor can accommodate up to 24 local or remote workstations), but that's enough to meet most, if not all, of Datapoint's customers' needs.

"I think it's fair to say that American industry, and industry outside the U.S., is not prepared for integrated products," O'Kelley says. "I think we're going to have to pioneer that preparedness like we pioneered dispersed data processing and communications management." (Datapoint, Burroughs and Sycor, now a part of Northern Telecom, were among

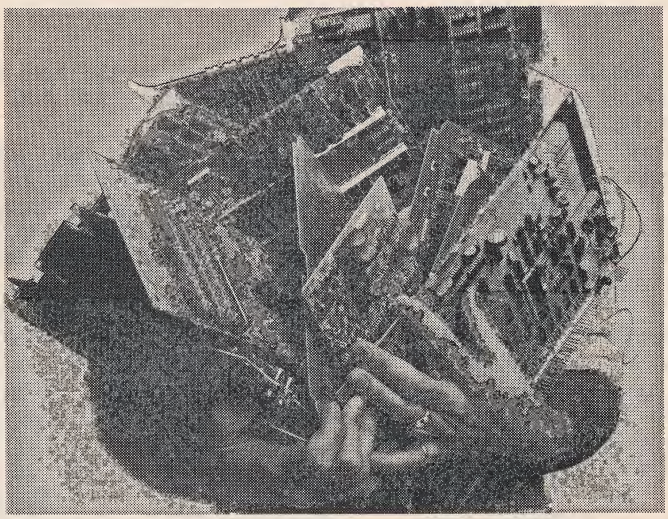
Continued on page 64

Growth of total office equipment shipments
by product share



Source: Quantum Science Corp.

Centralized testing makes you bring your boards to the tester



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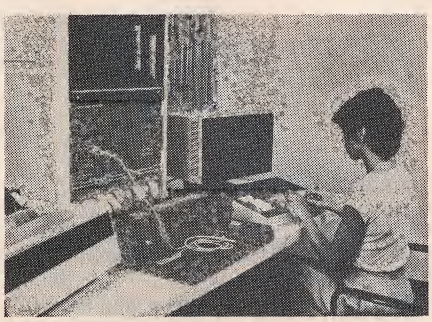
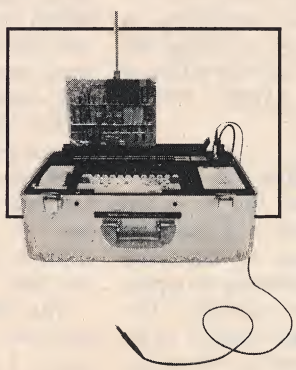
IN FACTORY AND FIELD: The LTS is program-compatible with the Omnicomp Portable Service Processor (PSP), marketed by GenRad as the GR2225 Functional Field Tester. This means that you can use the GR2225 to extend distributed testing to your field service offices to reduce the repair pipeline. Call or write Omnicomp or your nearest GenRad office for more information on the LTS or the GR2225. Find out how distributed testing can reduce your testing costs.



The LTS is mobile, costs less than $50,000, has 384 software programmable driver/sensor pins. It tests microprocessor and dynamic memory boards and isolates faults with a guided probe. Its IEEE-488 Interface Bus lets you add analog stimulus, measurement, and scanning instruments.



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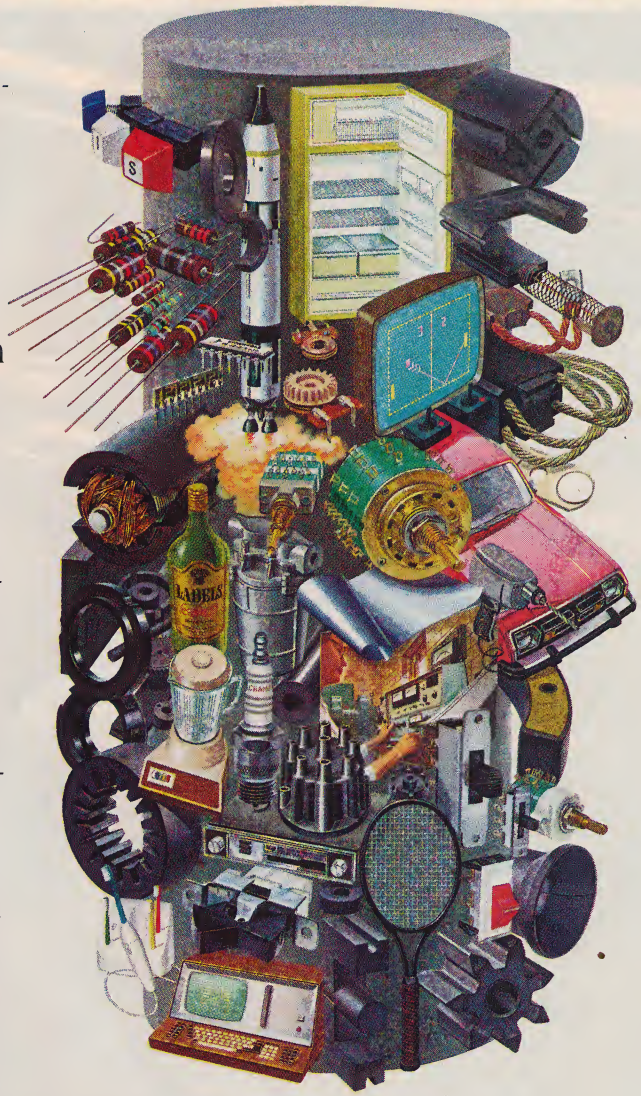

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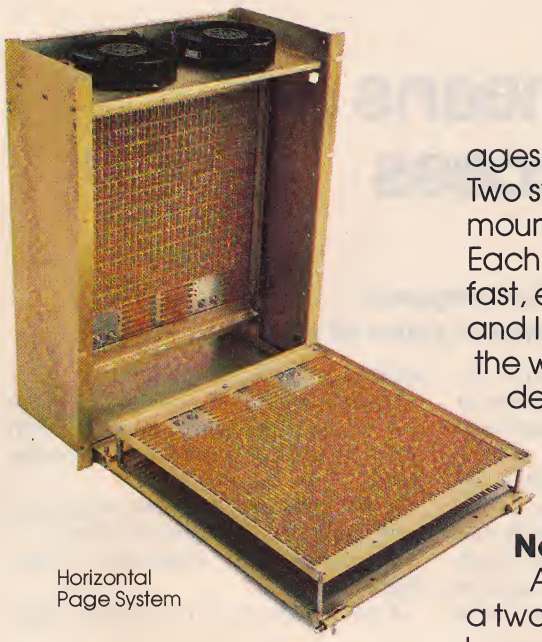

Horizontal
Page System

stitch-weld; and single, double and triple width boards in the same enclosure. Choose either a continuous backplane or three separate backplanes to provide the different voltages and grounds needed to mix analog and digital boards. All are assembled with 96-pin I/O connectors. Flexible spacing lets you use up to four wire-wrap boards (1.2" spacing) or 7 stitch-weld boards (.6" spacing) or a combination of the two. Guide separators let you mix different width boards. Fans are optional.

Horizontal Page System

Handles up to four Augat panels and packages up to 1,560 16-pin ICs. Two systems can be mounted back-to-back. Each page folds down for fast, easy troubleshooting and IC replacement. And, the whole system was designed to make cabling easy. Two top-mounted fans are optional.

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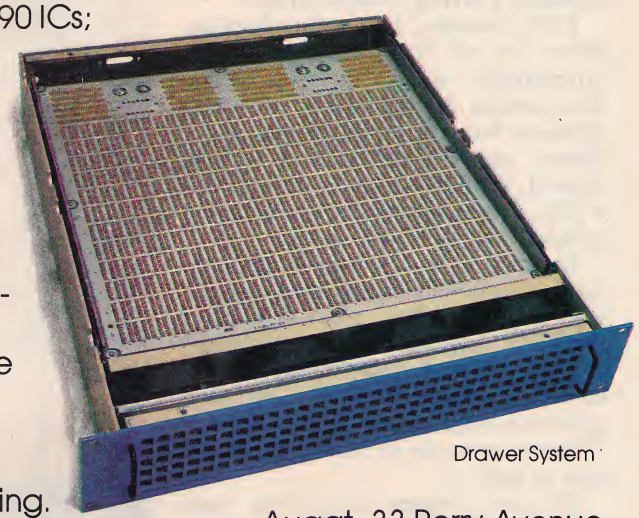

Drawer System

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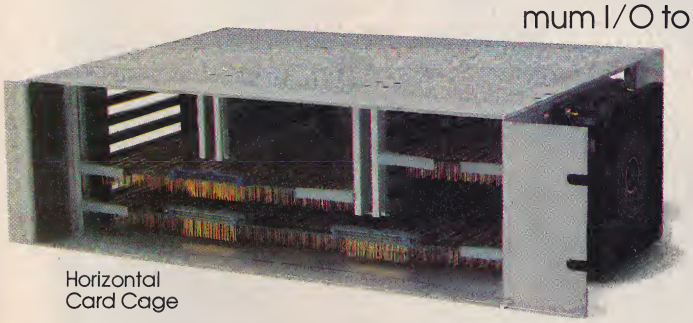

Horizontal
Card Cage

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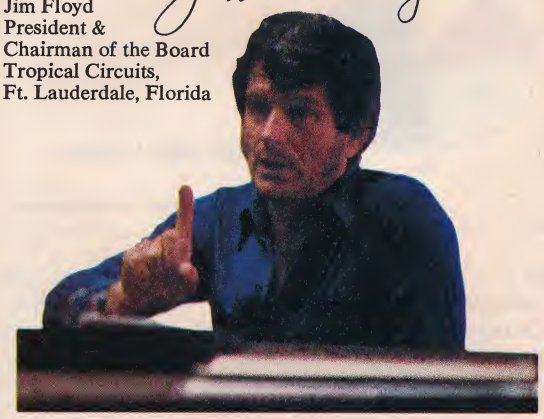

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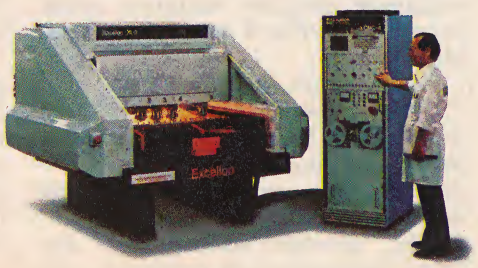

The XL-3 Drilling System.

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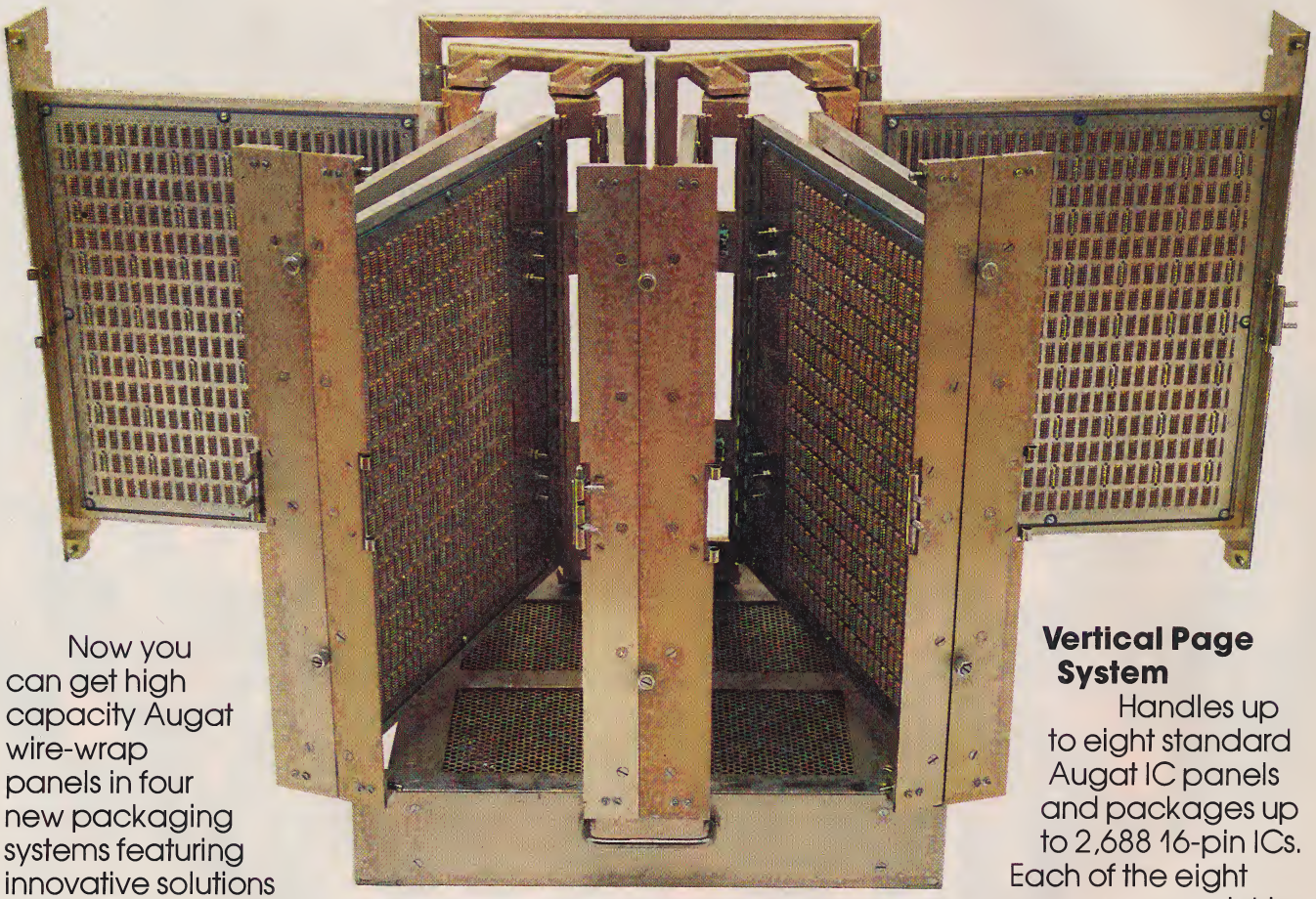

Vertical Page System

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Vertical Page System

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Datapoint's system architecture handles both data and text processing, so one system forms the foundation of its integrated product.

the first vendors to offer distributed data processing systems.)

"I believe that the educational level of the work force, on the average, will increase with time and so will its ability to use more sophisticated tools," O'Kelley adds. "Frankly, I think innovative managers will embrace integrated office systems immediately. At the same time, there's going to be a great deal of cautious waiting on the part of other managers."

O'Kelley knows that this kind of spotty acceptance characterizes the first stage of any product's life cycle, and he uses his understanding of these cycles to carefully position Datapoint in its chosen markets. Thus under O'Kelley's guidance, Datapoint's revenues rose 43 percent during 1979's fiscal year (ended July 31) to top $232 million, up from the previous year's $162 million. During 1980's first quarter, Datapoint has maintained its growth rate, with reported revenues up more than 40 percent over those of the corresponding quarter a year earlier.

"As I see it, every successful new concept passes through three phases," O'Kelley explains. "The first phase sees a few pioneers and innovators striving to get market acceptance for the concept. The second phase sees the concept's acceptance, and the third phase is the mature market.

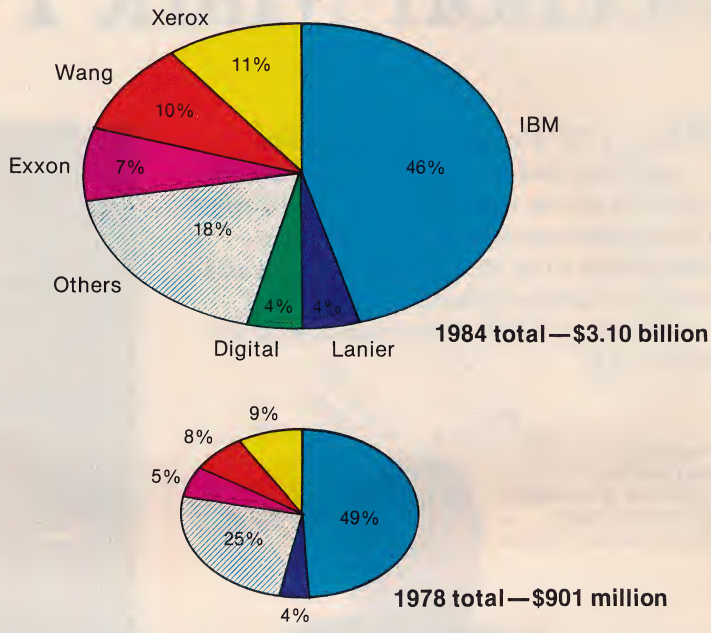
"During the first phase, industry shipments experience reasonable growth but are not very great. In the second phase, total industry shipments pick up very strongly and grow much more rapidly. Then the market matures and the growth rate slows down, but it's a very sizable market.

"In phase one, you see a few innovative companies. In phase two, the innovators have proved the concept's viability and other companies move in, increasing competition and causing a shakeout. In the third phase, you end up with a few companies having major market shares and making good money."

O'Kelley believes, and many market participants and observers concur, that communications management is still in phase one and the integrated office is just getting off the ground. He puts mainframe computer markets in phase three but distributed data processing in phase two.

"Look what's happened," he says. "Some of the innovators have been acquired, and the only two independents left are Datapoint and Four Phase. So dispersed data processing is here, and we've seen entries from Data General, Digital, Hewlett-Packard, IBM and Texas Instruments—all companies with resources larger than Datapoint's."

Text editing market shares
(shipped value)



Source: Quantum Science Corp.

These companies present formidable competition to O'Kelley and Datapoint. "Any time you're in the jungle with an elephant like IBM, you've got to stay out of the way of those footsteps," O'Kelley says. "I mean there just isn't anybody else in that category. IBM's to be emulated in many respects, although not in some. For example, it doesn't maintain compatibility."

O'Kelley doesn't see Four Phase as a competitor on the same scale as Data General, Digital, HP or TI. "When you look at Four Phase, it doesn't have the resources the others have," he says. "Today we don't either, from a standpoint of total financial resources, but I think we're more dedicated to the marketplace as a total corporate entity than they are. Data General, Digital and the others are in much more diversified businesses, and their major source of revenue comes from the OEM business; they're not as dedicated to the end user sector as we are.

"Of course, these are good companies," O'Kelley continues. "We respect them, but we believe we're in a reasonably unique position because we maintain both software and hardware product compatibility over the life of the company. These other companies can't necessarily say that."

Compatibility will certainly give Datapoint a strong selling point, especially for the versatility it affords: Datapoint can still sell single-function ARC systems. And most industry observers agree that pure data processing systems won't disappear, nor will pure word processing systems. There'll be separate niches for single-function and multifunction systems, and in all probability some systems will exist side by side.

Although all bodes well for Datapoint during this pioneering stage of the market, it might face some difficulty when the giant manufacturers move in alongside it and Xerox. Digital has all the elements of the integrated system and needs only to label and market them as such, and IBM is just on the outskirts with a low profile.

"When IBM announces a product, that means it's an okay concept, an okay approach," O'Kelley says. "Before IBM announced its 8100, an independently conducted survey indicated that only 20 percent of the data processing managers in the U.S. had even experimented with distributed data processing. As soon as IBM announced, the other 80 percent became candidates. From our viewpoint, we might lose a little bit from the 20 percent after an IBM announcement, but I think we'll more than make up for it by what we'll gain from the 80 percent."—*H.P. Burstyn*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The market for in-circuit test systems grew 88 percent last year.

the broad-line approach or the way of the specialist. Either path can offer rewards. Trying to walk both paths at the same time is a guaranteed formula for failure."

Zehntel's "niche" has already attracted such competitors as Computer Automation, GenRad, Hewlett-Packard and Teradyne, which all entered the market within the past two years. Dataquest's Galen Wampler says if Zehntel loses market share in the future, it wouldn't be because of any technical weaknesses but rather its competitors' strengths.

Zehntel is fully aware of this encroachment upon its territory and says its strategic planning accounts for the competition. "We're constantly looking at the competition with no undue concern. But we don't want to meet competitive features one on one," says Funk. He notes that when a competitor brings out a new system, Zehntel has often "been down that path before."

Funk says although his company will remain essentially in the in-circuit market, "there'll be many embellishments and improvements in future systems."

Considering itself a technological leader in the market, Zehntel claims a number of "firsts" under its belt. It says it offered the first computer-controlled tester in 1976, the same year Faultfinders introduced one. And Zehntel's 800 line is the first system to simplify digital in-circuit testing and extend the digital capability to LSI devices, claims Pynn.

"Superior workmanship, reliability"

Bunker Ramo's Cyr notes that the decision to purchase Zehntel's system versus a competitor's was difficult. "We were impressed with the way people were using both systems. It wasn't a clear-cut decision." He says from test and repeatability standpoints, both systems performed similarly. "But we based our purchase on superior reliability, maintainability, self-diagnostics and workmanship of the system, and we feel Zehntel was the right choice," he says.

Cyr's satisfaction with the Zehntel system also comes from use of its software package. "It's capable of writing good, powerful programs in a relatively short time." And he notes that while Zehntel's price was higher than the competitive system's, "it was worth it."

Bunker Ramo received its first system in June 1978 and the second in February of last year. Both were delivered on time, says Cyr. "In both cases, my men, trained by Zehntel, had the system up and running on the same day as delivery."

Data Precision is another satisfied customer. President Harold Goldberg says the Troubleshooter 400A, purchased in March 1979, cut way back on the number of inspection people required. He says Zehntel is cooperative and provides good service: "It's been a very positive experience."

In Bunker Ramo's decision, one factor that almost worked against Zehntel is its location on the West Coast. The competitor, says Cyr, is located in the East, closer to Bunker Ramo. But prior to the decision, Zehntel opened up a support and sales office in Seabrook, N.H., which clinched the purchase.

Service and commitment emphasized

Service is vital to ATE customers because when their test equipment goes down, their production lines stop. Funk points to Zehntel's commitment to customer service as a major strength. "Our priority is to the installed customer. If his system goes down, we delay shipments if we must to ensure his tester is up and running as quickly as possible," says Funk.

Its six years of experience and commitment to the business should also help safeguard Zehntel's success, and the onslaught of powerful new competition in a sense makes Zehntel's job easier, says Funk. It lends credibility to the in-circuit test market and helps keep supply in balance with demand. "Because of the dramatic growth of the market, we simply cannot meet all the demand ourselves," he explains.

"But the fact that we're not becoming a 'soup to nuts' supplier should prove to our customers that we're totally committed to the in-circuit business," Funk adds. "All our strategies, know-how, background, people and dollars go into the in-circuit test market. We have nothing else to fall back on; we'll make sure we succeed."—*D. Domenicali*

Vital Statistics

PLANTRONICS

Cupertino, Calif.

All figures for fiscal year ending June 2, 1979.	
Net sales	$86,579,000
Net income	$8,731,000
Net income as % of sales	10.1%
R&D as % of sales	8.9%
Cost of sales (manufacturing costs as % of sales)	50.0%
Number of employees	1906
Sales per employee	$45,424
Net income per employee	$4581
Current ratio (assets to liabilities)	4.3:1
Debt/equity ratio	0.14:1

Zehntel gets a parent, Plantronics gains a president

Zehntel's growth points up the personal success of one of its founders, William Martin. In 1966 Martin and four others founded Zehntel as a custom house making digital controllers such as blood plasma counters. In 1970 Zehntel started supplying functional testers, but in 1974 it entered the in-circuit board test market via Systemation's bed-of-nails technique, which opened the in-circuit market.

Zehntel's merger with Plantronics was based on their personal and business relationship. In 1972 Plantronics, one of Zehntel's customers, had made financial agreements with Zehntel and was interested in acquiring it. At that time Zehntel's functional test business was almost exclusively directed to the telecommunications industry. When Zehntel began supplying in-circuit testers and broadening its customer base, Plantronics forestalled its acquisition decision.

But as Zehntel continued to grow, Plantronics realized it wanted the company to become part of its family and acquired Zehntel in 1978.

Last May, Martin took the ultimate career path and became president of Plantronics, replacing Jack McKittrick, who became chairman of the board. Zehntel's presidency was awarded to Herb Funk, who joined Zehntel in 1978 as vice president of marketing and previously had been a management consultant for Zehntel and other Bay area corporations. Craig Pynn was promoted to marketing manager from his prior position of applications manager.

With Plantronics' backing, Zehntel will be better prepared for future growth. Its parent's capital (over $80 million in sales) will help solve the capacity problem that Zehntel faces now that it has outgrown the 60,000-square foot Walnut Creek, Calif., facility built in 1978. ■

Micralign® 200 Series... Higher throughput than step-and-repeat at a much lower price.

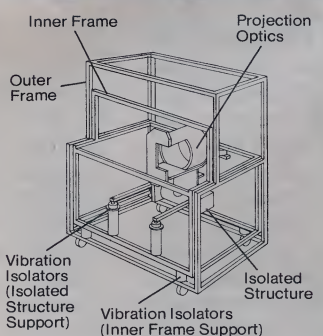
Perkin-Elmer designed the new Micralign Model 200 to be the most cost-effective projection mask aligner available. In performance, it achieves 2-micron geometries or better in production, distortion/magnification tolerance of 0.25 micron, and 4 percent uniformity of illumination. Options available include automatic wafer loading and automatic alignment. Soon to be available: deep UV optical coatings for still smaller geometries.

Compared to the leading step-and-repeat aligner, the Micralign Model 200 delivers outstanding performance for not much more than half the cost. It takes about a quarter of the floor space. It provides consistently higher throughput regardless of die size.

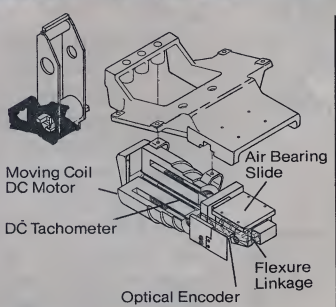
The Model 200's remarkable performance is the result of a number of major innovations.

Improved optical design and fabrication
We improved the optical design to provide increased resolution and depth of focus. Optical manufacturing tolerances are five times tighter to ensure precise overlay from aligner to aligner.

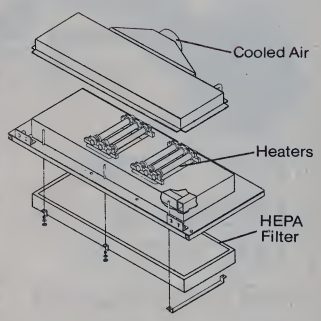
Near-zero vibration
We minimized vibration. We constructed the Model 200 with two frames—one inside the other. The inner frame, which carries the projection optics and carriage drive, is completely isolated from the outer frame.



We incorporated a superb linear motor carriage drive with air bearing slide. This drive does more than eliminate vibration. With the air bearing feature there's no contact and no wear. And no limit to carriage drive durability.



Built-in environmental control
We provided the Model 200 with a built-in environmental chamber. External air, supplied by you or from our optional air conditioning system, is blown through a HEPA filter and heating elements built into the Model 200 top cover. A positive-pressure, class 100 environment is carefully controlled to better than 1°F.



We included a separate thermal control for the mask, to compensate for mask run-out.

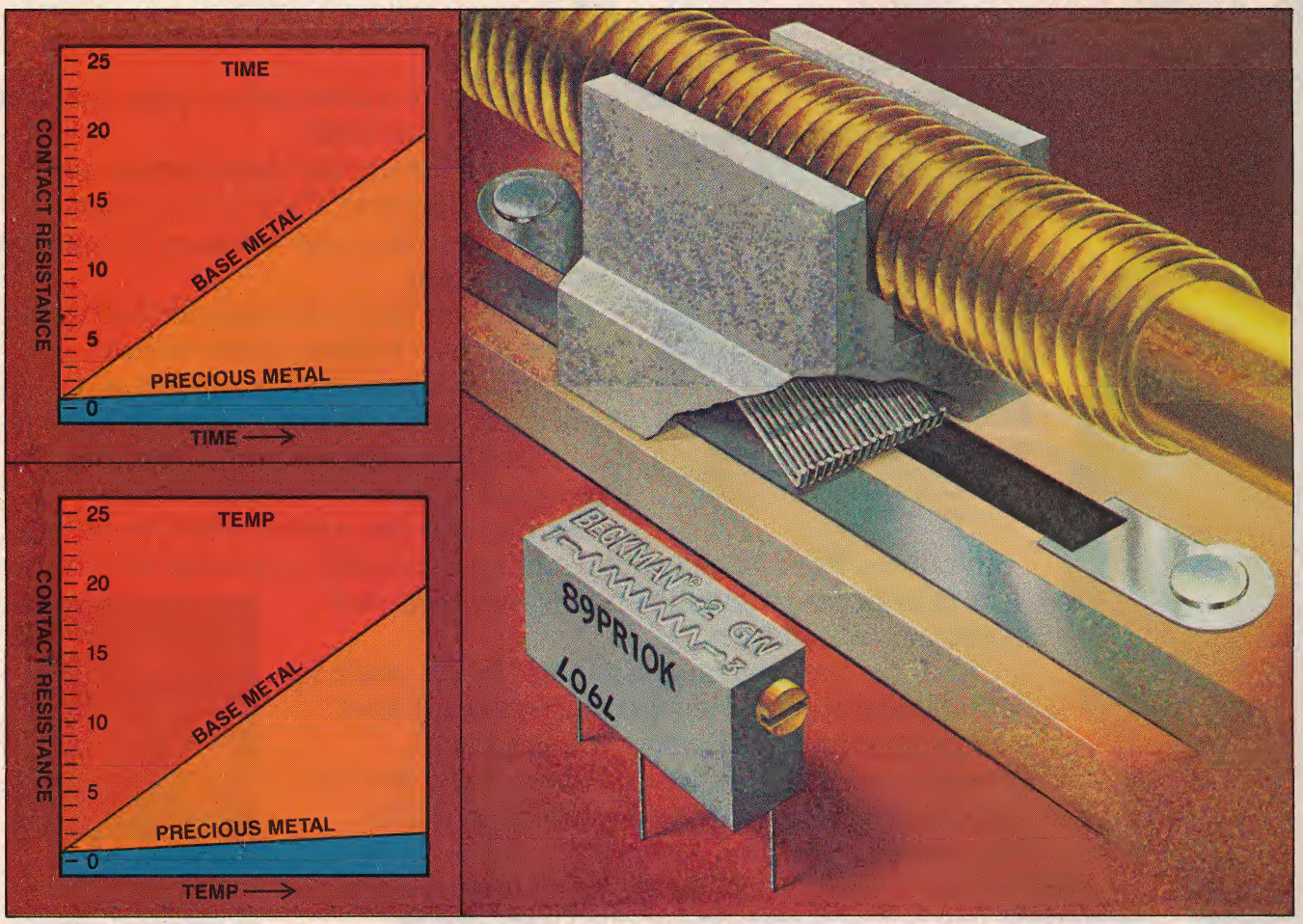
No mask contamination
We designed a sealed mask carrier for the Model 200. You put the mask in the special carrier right in the mask department. Seal it. When you load the sealed carrier in the Model 200, the cover plates are automatically removed. After use, the cover plates are automatically replaced.

Proven production capabilities
Perkin-Elmer, the leader in projection mask alignment systems, offers six years of proven production capability, with an excellent training and service record.

Get all the facts
These are just a few of the features that make the Micralign Model 200 Series a completely new concept in projection mask aligners. Get more details on how these and other improvements in design can translate into improvements in your production. For literature, write Perkin-Elmer Corporation, Microlithography Division, 50 Danbury Road, Wilton, CT 06897. Or phone (203) 762-6057.

PERKIN-ELMER

DESIGN BECKMAN TRIMMERS IN. DESIGN PROBLEMS OUT.



Our precious metal contacts let you set and forget.

There are many reasons to make Beckman your trimmer choice. But there's one that's actually worth its weight in gold. It's our precious metal brush contact. Unique to the industry. And invaluable to your application needs. With it, you can forget about long term drift.

In the rheostat mode, our precious metal brush contact would drift from its original setting typically less than 2 ohms with time and temperature changes. A base metal stamped contact would drift typically as much as 20 ohms under the same conditions. That makes our precious metal contact 10 times better in setting stability alone! This is particularly important in low resistance settings.

In addition, our brush contact offers low noise and high overall reliability. So when you specify Beckman, you get a superior product in every way. All at a competitive price.

To find out more about the trimmers you set and forget, contact your local Beckman distributor. Or write: Helipot Division, Beckman Instruments, Inc., 2500 Harbor Boulevard, Fullerton, California 92634. In Europe write: Beckman Instruments (Belgium) S.A., 14, Avenue Hamoir, 1180 Bruxelles, Belgium.

Telex: 23577.

BECKMAN

claims any gain in performance will be less than double the Cray-1's and will depend on the application.

Rollwagon has lowered the lease price on the new system 25 percent to increase the lease base quickly, so Cray Research can operate from lease revenues alone. A third of that base will be commercial customers. The new series is also more aggressively priced, from $4.8 million to $15 million rather than the $5.4 million to $9 million cost of the Cray-1, with the 10 percent cost reduction representing manufacturing and technology savings.

To meet new manufacturing requirements Rollwagon will add to the production force in the Chippewa Falls, Wis., manufacturing plant and step up production to nine or ten systems this year, adding one or two more systems each year thereafter.

No abdication

The commercialization of the Cray-1, which is 10 times faster than the largest IBM machine, does not mean the company will abdicate leadership in the super scientific market. When talk of producing less powerful machines surfaced, Seymour Cray minced no words: The company will produce nothing smaller than the Cray-1, and technological creativity must be unencumbered.

Seymour Cray is hard at work on the Cray-2 in his Chippewa Falls laboratory. The second-generation machine, due in the mid-'80s, will have five times the computing speed of the Cray-1. He has already slated a Cray-3 for the 1990s.

The company has allocated a whopping 15 percent of revenues to continue the company's technical development, about $7.5 million in 1979, over the next five years. Five percent goes to the Cray-2 with the remaining 10 percent evenly divided between hardware development for the Cray-1 and software development for the Cray-1S to adapt the systems to commercial use.

To protect research employees from the influence of Cray Research's increasingly aggressive commercial activities and foster the technological innovation that its founder demands, last summer management set up Cray Laboratories, the wholly owned research and development subsidiary that will be completed this year in Boulder and will work in conjunction with Seymour Cray's R&D team in Wisconsin.

While Cray works on the Cray-2, the new lab, under chief operating officer G. Stuart Patterson, a former Cray-1 user with the government, will initially concentrate on software development for the Cray-1 and 1S. The new arrangement, which has Patterson reporting directly to Seymour Cray, separates future product research from marketing existing products.

"A company that becomes more commercial can put limits on technical creativity," says Rollwagon. "We're trying to avoid that by creating Cray Laboratories."

The strain of commercialization on the research team was evident, Patterson says, when the Cray-1S was in development. The Wisconsin research staff debugged the system, work that took it away from development of the Cray-2. The engineering team at Cray Research will complete any improvements on the new systems in the future. "The new arrangement will protect R&D from the drain of the commercial side," says Patterson.

But equally important, Patterson's group will succeed the 54-year-old Seymour Cray, eventually taking over research and development. "We all recognize Seymour won't be designing computers forever," says Rollwagon. "We need to replace his function even if we can't replace him as an individual."

That arrangement is a relief to customers, analysts and stockholders who know only too well that the Cray-1 is the product of one man's mind. "The lab is a good move," says Frank Mulhaney, one of Cray Research's original founders and a board member until last year. "It will develop people within the organization and help convince the public that there will be a Cray Research without Seymour Cray."

Moving into commercial markets and creating Cray Laboratories might balance the concerns of interest groups and ensure a successor to Seymour Cray, but it also imposes the strains of growth and competition on the firm as never before. In the commercial markets as other computer makers add to their computing power, Cray will confront

Vital Statistics

CRAY RESEARCH, INC.
Mendota Heights, Minn.

All figures for fiscal year ended December 31.

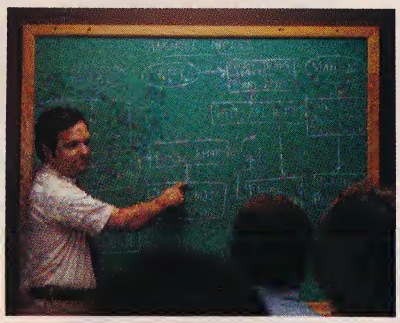
	1978	1979
Net revenues	$17,177,000	$11,394,000
Net income	3,501,000	2,027,000
Net income as % of revenues	20.4%	17.8%
R&D as % of revenues	13.7%	16.7%
Cost of sales, rentals & services as a % of revenues	40.7%	48.9%
Number of employees	321	199
Revenues per employee	53,511	57,256
Net income per employee	10,907	10,185
Current ratio (assets to liabilities)	3.6:1	16.1:1
Debt/equity ratio	0.23:1	0.23:1

Total revenues for nine months ended September 30, 1979: $28,424,000.

The last thing you want to do is fall for a sweet-talking ATE company, and find yourself left without any visible means of support.

That won't happen if your ATE company is GenRad. That's because no other company offers you as many different levels of support.

First, you'll meet our Product Specialist. He'll take a close look at your operation and analyze your needs.



GenRad Applications Engineers work closely with your test system engineers to develop the most effective solutions to your testing problems.

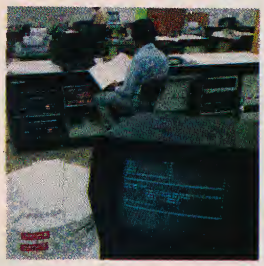
Then you'll meet our Applications and Software Engineers. Their job is to fine-tune both hardware and software to your specific application.

And as your needs change, our Software Support Group is always there to help. Generating software device models and application notes, and working with you on debugging and enhancements. Just give them a call whenever you need them.

GenRad also has a lot of other people you can call on. For instance, our Training Specialists will make sure every one of your programmers understands their new system inside and out.

And our Programming Services Group, made up of full-time applications specialists, can off-load your programmers whenever you need help.

If a problem does occur, we can have a Field Service Specialist right there and solving any problem within hours of your call.



GenRad's Programming Services Group is always ready to off-load your programmers whenever you need help.

We even help you solve problems *before* they develop by putting you in touch with one of our User Groups.

GenRad User Groups meet often to discuss common concerns and share ideas. One user may already have an answer to a testing problem you're working on.

People like you who own and use GenRad equipment. In many cases, you'll be able to benefit from the experience of someone who's had a testing problem similar to yours.

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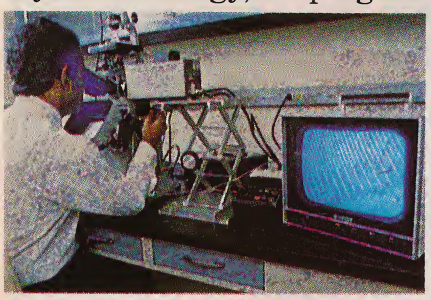
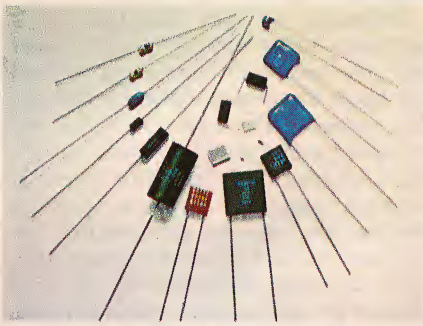
Multilayer ceramic capacitors are the fastest growing sector of the capacitor market. They're the approved choice for designs requiring economy, efficiency, and consistent reliability. And now, multilayer applications are expanding to include areas previously reserved for micas, films, and tantalums. Areas that demand a capacitor technology that delivers cost-effective performance when you need it.

AVX is the leader in multilayer technology, keeping pace with their growth through the continuing development of more efficient ceramic formulations, more cost effective electrode metals, and more economical packaging configurations.



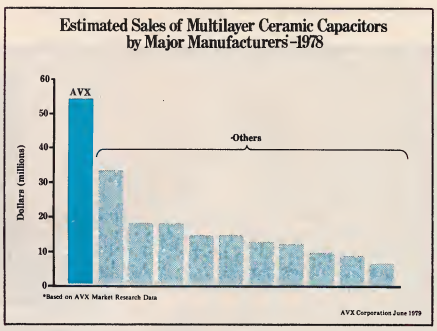
AVX research centers have developed superior capacitor materials and production techniques to achieve extremely high reliability in product performance.



AVX produces in volume a full range of multilayer ceramic capacitors incorporating advanced technology materials and automated production methods that result in reliability levels that far exceed the highest military specification requirements.

AVX multilayer ceramic technology is supported by a firm commitment to Research and Development that investigates every phase of capacitor design and application. And explores emerging requirements, while solving today's problems to assure that both your present and future designs include the most advanced capacitor technology available.

Why not get on board with the world leader in the design and manufacture of multilayer ceramic capacitors. Our technology may be your design solution.



AVX maintains a strong leadership position in the multilayer ceramic capacitor market, and supports that position with a continuing committment to quality and technological excellence.

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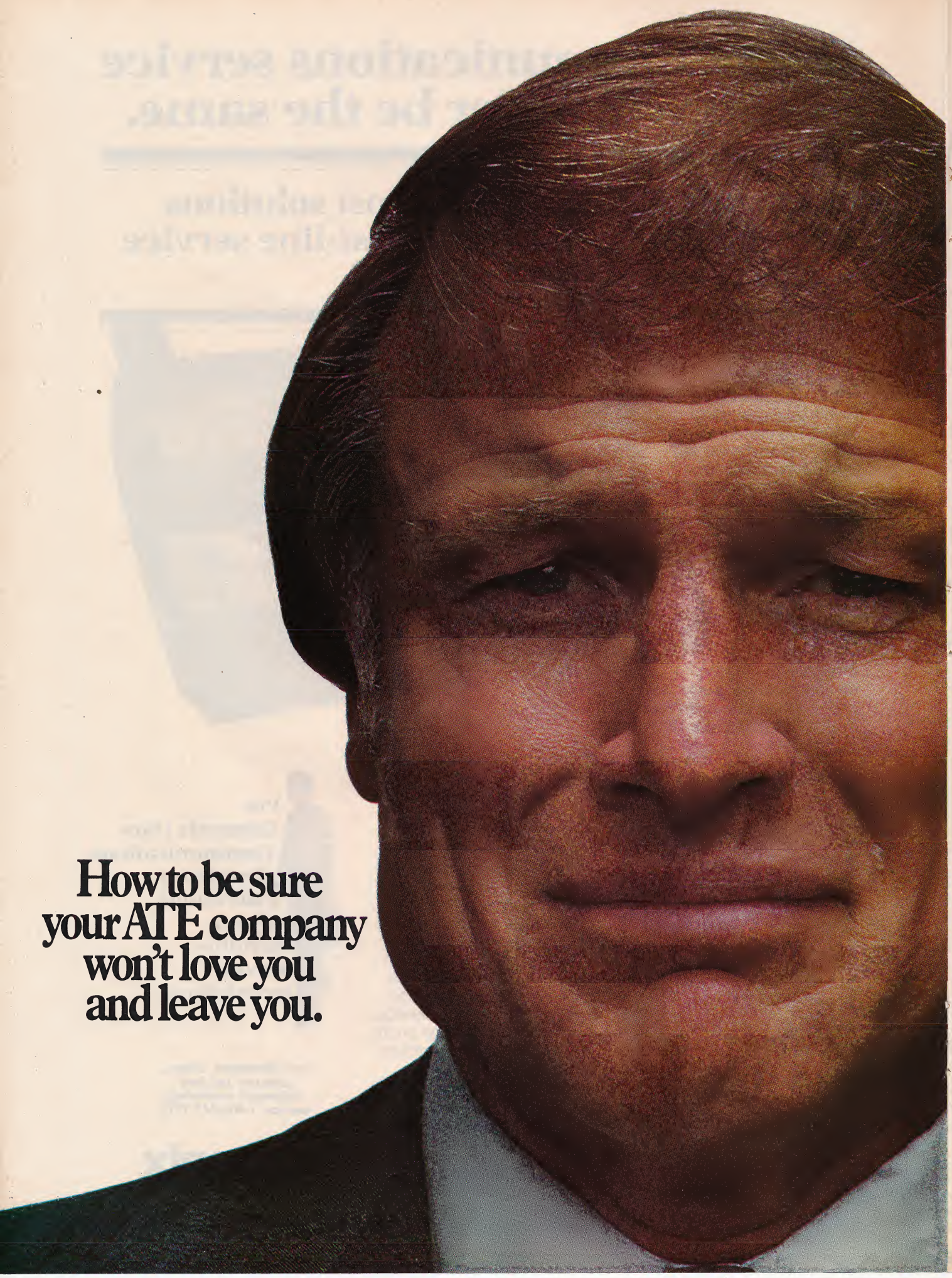

How to be sure your ATE company won't love you and leave you.

Control Data threw down the gauntlet again in the supercomputer market and will duel fiercely with Cray.

competition from the larger IBM, CDC and Sperry Corp. models.

Burroughs Corp., the $3 billion mainframe maker second in revenues and profits only to IBM, appears to be making a play for the scientific market. Although deliveries of the Scientific Processor announced in 1976 have been stalled, the company will ship its first machine to Japan this year. Burroughs could threaten Cray if it aggressively pursues the market, but analysts doubt the company's staying power. "Burroughs has lagged in its supercomputer development," says John Christianson, vice president of A.G. Becker. "It could well make a few models and then pull out as IBM did."

Burroughs might be a questionable threat, but CDC certainly isn't. Control Data threw down the gauntlet again in the supercomputer market with the Cyber 203, a redesign of the CDC Star 100, a machine plagued with problems since its introduction in 1970. Although CDC lost an order to Cray on an Air Force bid last September, it sold the first 203 to the Navy last November. The 203 is supposed to approach the performance of the Cray system in certain applications, and Control Data expects to win duels with Cray on the backing of its long experience in systems support and software.

Analysts agree that CDC's strength in peripherals, other computer-related equipment and software can be an advantage. "CDC will find some areas where the 203 will compete effectively," says Christianson. Mulhaney agrees: "Cray will have to be selective in its bidding and prepared to lose some important orders."

Although no one disputes Cray's hegemony in the supercomputer market now, the move into commercial markets will boost the cost of sales, service and development. The new customers will demand greater software sophistication, and Cray must catch up to CDC's lead in software expertise. Analysts question whether the company can generate the revenues to duel effectively with CDC. They say Cray Research will be hard pressed for cash unless it can sell at least two or three systems each year.

But John Carlson, vice president for finance, insists the company can finance growth over the next five years without additional equity or debt financing by building the lease base, selling those several systems a year and using a $15 million revolving credit line.

The big question

However, Cray doesn't have the financial staying power of CDC. Business can fluctuate wildly. Last year with no sales in the third quarter, the company posted a net loss. Although revenues are expected to climb 22 percent this year to about $62 million, earnings will rise only about 12 percent to $12 million.

The high end of the commercial market is far more susceptible to price cuts than the scientific sector is. If CDC with all its resources starts a price war, analysts wonder whether Cray can combat the cuts in addition to paying the added costs of servicing commercial customers and funding a separate R&D center.

Says Christianson, "The big problem and the big question for Cray in the next few years is, 'What is CDC going to do?'"—*E.T. Smith*

Data Communications service costs will never be the same.

Tektronix. First with low cost solutions designed for use by your first-line service technicians.

When a data communications network goes down, you don't want to waste time guessing where the problem lies. So Tektronix developed the 832 and 833, two data communications testers that non-specialists can use to pinpoint most communications problems on the first call. You get the answers you need right away without relying on specialists and sophisticated, expensive analyzers — and that saves you time and money.

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You'll solve more problems faster! The specialists with their sophisticated analyzers will be free to deal with more complicated problems.

Easy to learn and operate, neither tester requires extensive data communications knowledge to use. And we make it even simpler with training aids and manuals.

Along with all this, the 832 and 833 are backed by Tektronix so you're guaranteed quality, reliability and service.

For more information on the 832 and 833 Data Communications Testers, call your nearest Tektronix Field Office or write to Tektronix, Inc., P.O. Box 1700, Beaverton, Oregon 97075.

Put Tektronix Data Communications Testers into the hands of your first-line service technicians.

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3D™ Air Freight (Delta Density Discount)™ gives you 40% off regular freight rates. Shipments with a density of 25 lbs. or more per cubic foot get 40% discount. Applies to non-containerized shipments of 250 lbs. or more and gets the same priority as regular air freight.

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DELTA
The airline run by professionals

DELTA IS READY WHEN YOU ARE®

Zehntel bets in-circuit testers will beat growing competition

One of the first commercial suppliers, the small company gambles on one product type while large competitors tout a broad-based approach to the growing ATE market.

Zehntel's key position in the in-circuit test market is being threatened by the recent moves of at least four major automatic test equipment (ATE) suppliers into that arena. Committed solely to the in-circuit business, Zehntel now faces competitors whose proven success lies in a broad-based ATE offering.

But Zehntel plans to stick with its commitment to in-circuit testers (which individually test components permanently mounted on a circuit board) with functional capabilities and not move into systems that only test boards functionally (and actually exercise the circuits to duplicate their performance in the system) or into component testing (which tests components before they're mounted on a board). Will Zehntel be able to continue its rapid growth and maintain its market share based solely on sales in a fast-growing but increasingly competitive market?

At least one user doesn't think so. Marty Cyr, director of quality assurance at Bunker Ramo in Trumbull, Conn., believes Zehntel might have to expand into IC or dynamic testers to uphold its position. He adds, "The satisfaction we get from Zehntel's Troubleshooter 400A system would have substantial weight if we decided to purchase a semiconductor tester and Zehntel offered one."

Zehntel's Funk: *"When a competitor brings out a new system, we've often been down that path before."*

Zehntel's response is that the growth of the industry comes from in-circuit test sales, and its lack of business in other ATE segments won't weaken its stance. "Everyone is moving into in-circuit testers," says Zehntel's president Herb Funk. "In the near future, boards will be universally tested on in-circuit systems with functional capabilities. With our strength of product and commitment to the business, we feel we'll always be a dominant factor in the market."

The best of both techniques

Zehntel's marketing manager Craig Pynn elaborates on the future of ATE: "I see the trend toward very large scale integration producing a need for a combination in-circuit/functional test system. What will probably happen is that the boundaries between in-circuit and functional testers will become fuzzy, and much of the terminology will be reduced to a matter of semantics."

Zehntel's strategy is to provide test systems for increasingly complex devices with an in-circuit emphasis. "We're in the production test market for repairable electronic assemblies," says Pynn. "While we have no intention of producing a purely functional board tester like GenRad's 1796, we will strengthen and improve the functional capabilities of our in-circuit testers."

Zehntel plans to dominate that area and integrate vertically by offering fixtures and programming packages, among other features. "We haven't ruled out the field service test market either, but we've made no commitments to that area yet," says Pynn.

Zehntel's current systems, the Troubleshooter 400A and 800, range in price from $75,000 to $160,000 and offer functional test capabilities for analog circuits, but their functional tests for digital ICs are more limited, says Pynn. To provide an adequate functional test for VLSI components on a system that's primarily in-circuit, the bed-of-nails technique (utilizing probe pins to make contact with the nodes on a board) might have to be improved and speed increased, he says.

Attractive growth of 88 percent

The new competitive flurry results from the dramatic growth of the

Continued on page 83

We didn't get to the the most 8-bit

The record speaks for itself. An independent survey revealed that during the first 9 months of 1979 General Instrument had topped all rivals by delivering over two and one-half million 8-bit microcomputers. That's more than twice as much as our nearest competitor.

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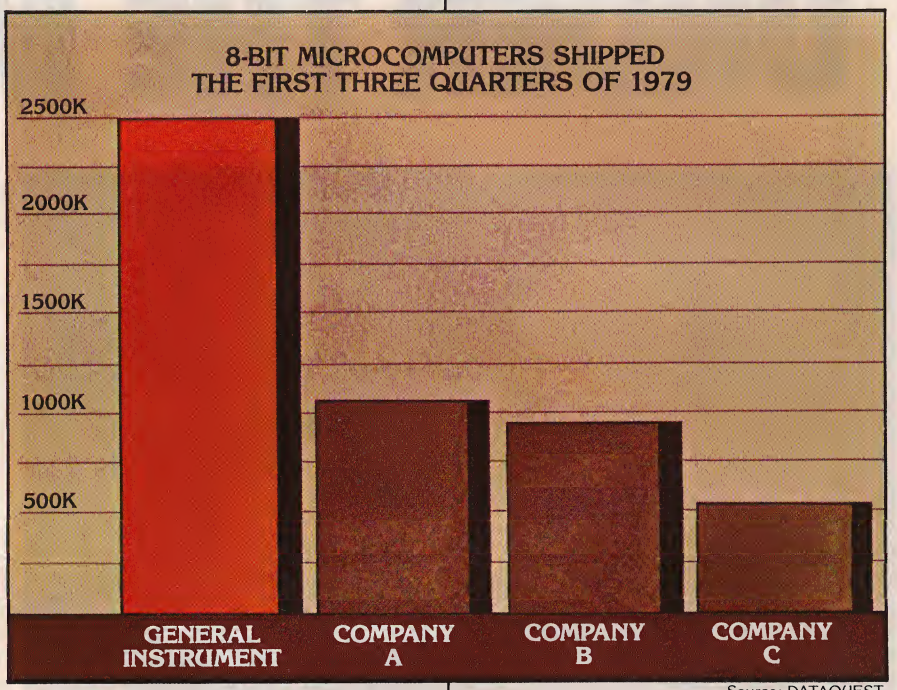
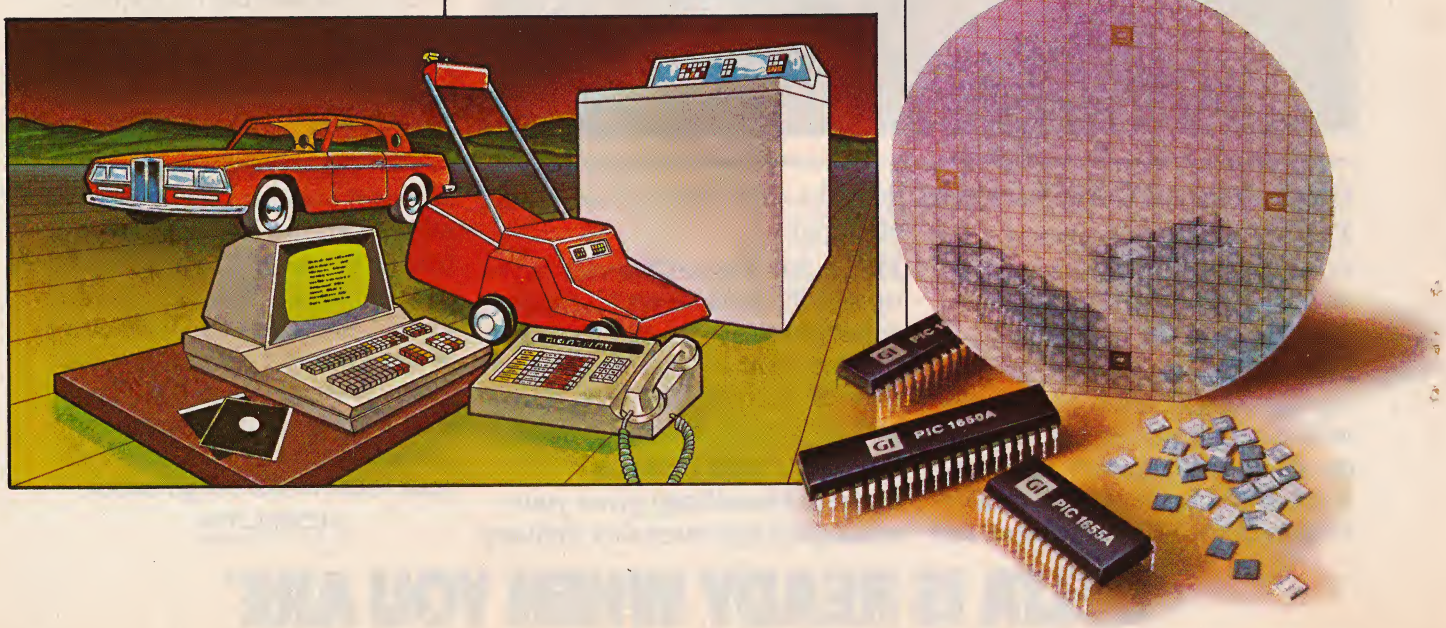
Specifically, our popular PIC family consists of the PIC 1650A with 512, 12-bit words of Read-Only-Memory, 32, 8-bit bytes of RAM, 32 I/O lines, real-time clock counter and two-level stack, packaged in a 40-pin DIP. The PIC 1655A is a reduced I/O version,20 I/O lines, packaged in a space-saving 28-pin DIP. Another version, the PIC 1656, has both external and internal interrupts, three-level stack and 20 I/O lines in a 28-pin DIP. A development microcomputer, without the ROM, is also available.



Source: DATAQUEST

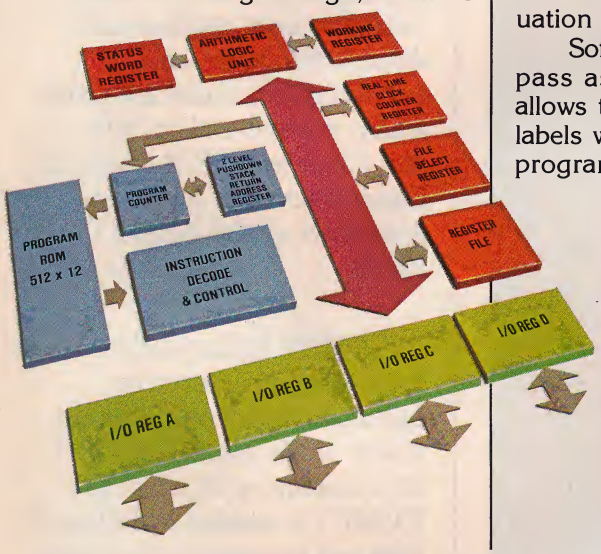
All PIC series chips feature a powerful 12-bit instruction set, instead of the usual 8-bit instruction word offered by other manufacturers, which allows applications with far less ROM.

So much for what we make. What our customers make of it is something else again. Our 8-bit microcomputers have proven them-



top by just delivering microcomputers.

selves in a wide variety of applications, including vending machines, consumer appliances such as washing machines and vacuum cleaners, electronic games, keyboards, display drives, TV/radio tuning systems, industrial timers, motor controls, security systems and automotive dashboard instrumentation. And as long a list as we may come up with, it still isn't long enough, because even as you're reading this, someone is designing a PIC into yet another challenging product application.



No matter how good a product may be — and ours is second to none — it needs the proper support to realize its full potential. Which is why we offer a complete, inexpensive set of hardware and software aids. This helps our customers in their design, development, and evaluation of a particular application.

Software includes PICAL, a two-pass assembler program, which allows the use of mnemonics and labels when writing the application program. By attaching our PICES In-Circuit Emulation System to any host computer, you instantly have a single-station PIC development system. Rounding out the support group is the PFD Series of PIC Field Demo systems which emulates the PIC Product Line, enabling the demonstration of an application program in the field before it's committed to a masked ROM.

And, as you'd expect, we provide a complete library of information documenting all there is to know about our systems, including a PICAL User Manual, PICES Data Manual, PIC Handbook and PFD Series Data Manual — all yours for the asking. For more information, write or call General Instrument Microelectronics, 600 West John Street, Hicksville, New York 11802, or call (516) 733-3107.

We help you compete.

GENERAL INSTRUMENT

FAIRCHILD

A lot of Fairchild thinking went into the world's most powerful computer.

A passion for building faster and faster computers led Cray Research into producing the Cray-1. This uniquely designed supercomputer is four times faster than anything built before it. And it's winning out against tough competition from some of the biggest names in the industry.

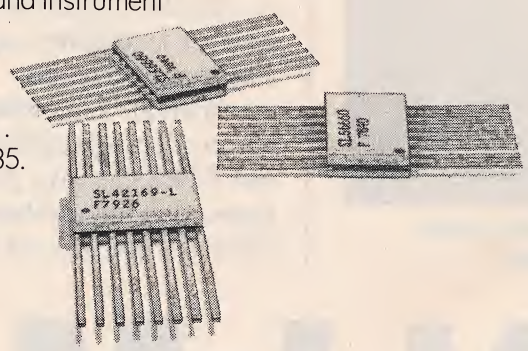
When Cray needed high-speed memories and logic for the Cray-1, they came to Fairchild. They knew we had everything it takes to help them build the highest-performance computers.

That's because Fairchild has grown up with the computer industry. We've been developing and delivering semiconductor components that have kept us on the leading edge of technology since its beginning. And we plan to stay there.

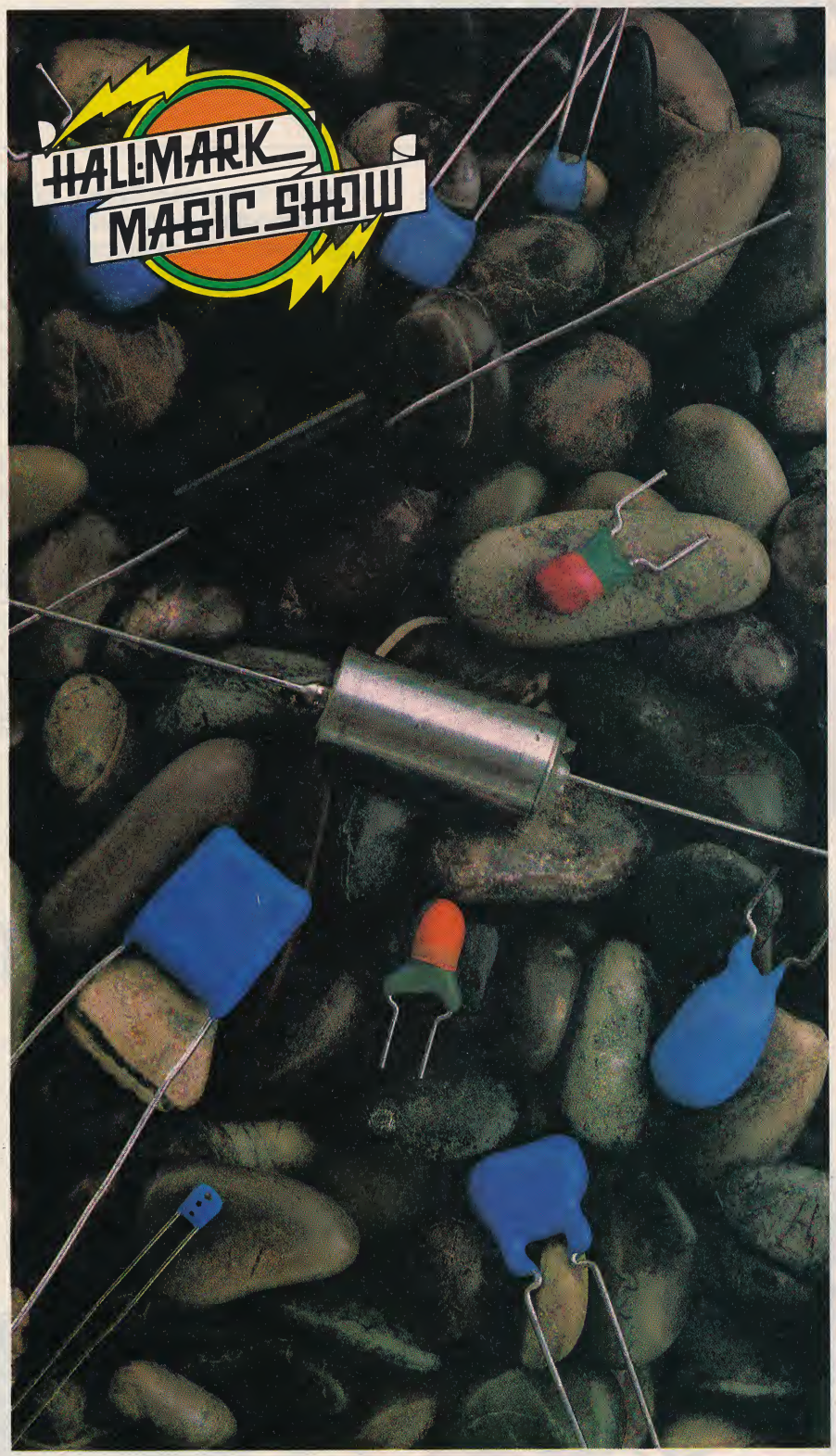
A quarter of a million chips of logic went into the Cray-1. Plus another seventy-three thousand memory devices. With the help of Fairchild logic and memories, the Cray-1 can process information much faster, while using much less power.

Thanks to Cray, the industry has a new supercomputer with a standard of performance that puts it in a class by itself. Thanks to us, the world's fastest computer has superior logic and great memories. We can do the same for you. And whatever else it takes to help you make a better computer.

Fairchild Camera and Instrument Corporation, Box 880A, Mountain View, CA 94042. Tel: (415) 962-4451. TWX: 910-379-6435.



THE KEMET CAPA



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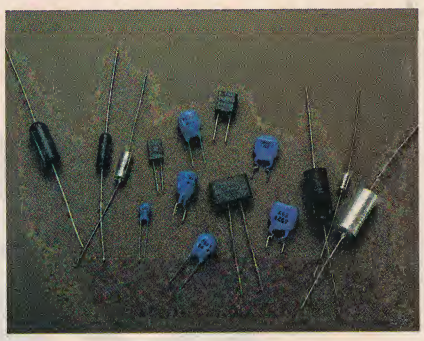
KEMET's reputation for making and delivering the capacitors you need is built on years of product performance. Solid tantalum, monolithic ceramic and precision film; hermetic seal, molded and dipped; miniature and subminiature; radial and axial leads; commercial or MIL — just about any OEM capacitor requirement can be covered by a member of the KEMET family.

KEMET is the world's largest manufacturer of tantalum capacitors; a direct result of the market demand for economy with reliability. KEMET's molded and dipped, chip and hermetic seal series come in a wide range of values and voltage ratings.



KEMET is the world's largest manufacturer of tantalums.

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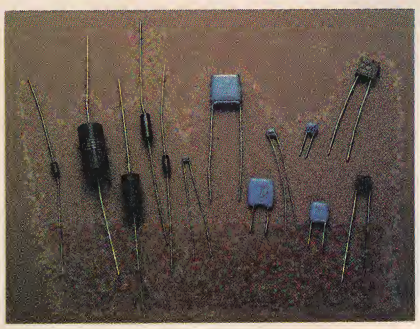

KEMET gives you a wide choice of ceramics.

And to keep the KEMET show in-tune with your capacitor needs, Hall-Mark's modification centers have KEMET inventory and the facilities to mark, grade and test such KEMET favorites as the M39014/01 and /02 (CKR05 and CKR06).

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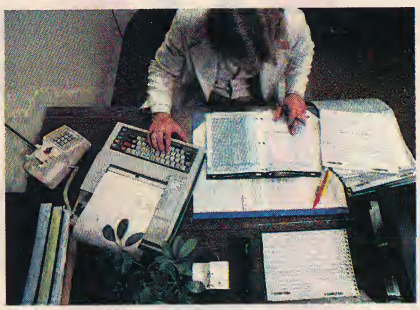

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